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(In full)

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Osnovnye rezul'taty i ocherednye zadachi issledovaniia pochv Kazakhstana.

[Principal results and urgent problems in the investigation of soils in Kazakhstan].

Akad. Nauk Kazakhskoi SSR. Vest., no. 11, p.42-53. Jan. 1954. 511 AL6

(In Russian)

In the directives of the XIXth Convention of the Communist Party of the Soviet Union, in the speech of Comrade G. M. Malenkov, during the fifth Session of the Supreme Soviet of USSR and in the resolution of the Plenum of TsK KPSS of September 7, 1953 a program was unfolded for a sharp rise in all branches of agricultural economy and for a creation of an abundance of agricultural products in our country, so as to satisfy the growing needs of the population of our country in food products and to provide raw materials for the light and the food industries in the next 2-3 years. A great role belongs to the Soviet science for a practical solution of this very urgent public problem and to Soviet soil science in particular, which is called upon to solve essential needs of the socialistic agriculture.

In the light of the historic decisions of the XIXth Convention and of the September Plenum of TsK KPSS it is necessary to review the present state of soil science in Kazakhstan, to critically evaluate its achievements and its defects, to find out the reasons for lagging and any erroneous opinions, so as to correctly evaluate all the problems and ways for further observations of the soils in our Republic, proceeding from general principles and problems of Soviet soil science.

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Soviet soil science is the scientific basis for socialistic agriculture.

Progressive materialistic ideas of the founders of the authentic soil science V. V. Dokuchaev, P. A. Kostychev and V. R. Williams about the ways of studies and of intelligent utilization of soils lead us to the conclusion that the main problem of the Soviet soil science is the study of essential qualities of the soil - its fertility, as well as the development of scientific fundamentals for improvements and methods for rational utilization of the fertility of the soil. A practical solution of this basic problem seems possible only on a basis of a thorough study of all factors of soil formation in their inter-relationship taking into consideration the leading role of biological factors, as well as the productive activity of man in each specific case. And the only correct principle for studying the soil is from the productive point of view, as in the last analysis, [Begin p.43] the fertility of the soil is concretely expressed in the productivity of agriculture. Only such an approach to the study of soil gives the opportunity for scientific foresight and forecast.

The Soil Sector, which was organized in 1939 as a part of the Kazakh Branch of the Academy of Science of USSR (and which became, since 1945, the Soil Institute of AN KazSSR) has worked on the systematization and the summarization of results of past researches of Kazakhstan soils, and at the same time conducted new soil-geographical researches of unstudied or little explored territories in Kazakhstan.

In 1945 a soil map was prepared for the whole territory of Kazakhstan, according to oblasts, as a result of this. This big generalizing work summed up the researches in the field of geography and mapping of soils in Kazakhstan and proved to be an important step in the history of development of soil science in Kazakh SSR.

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The new soil map of Kazakhstan served as a scientific basis for a quantitative calculation and a qualitative characteristic of land resources in our Republic.

On the basis of these oblasts soil maps of Kazakhstan, the Institute of Agriculture of the Kazakh Branch of VASKhNIL made a tabulation of the land value of the Republic according to oblasts and by raions, and drew up maps of lands which show the agroproductive content of soil areas, which were taken from the soil map.

The oblast' soil maps, in manuscript form, are utilized by many organizations of the Republic, but the maps are not yet published and, chiefly, through the Institute's fault. Now they need some corrections according to the research data of late years.

A survey soil map of Kazakhstan on a scale of 1: 2,500,000 was compiled according to materials of the oblasts soil maps, it was published in 1948. This map serves as visual aid for studying purposes and for learning about natural conditions in our Republic.

Thus, the compiling of oblasts soil maps and of survey soil maps of Kazakhstan on a scale of 1: 2,500,000 filled in one of the essential gaps in the field of geography and cartography of soils of Kazakh SSR, and the first stage of work on studies of soils and on tabulation of land resources of the Republic, as a whole, was completed.

Simultaneously with soil-geographical researches, in 1939, the Soil Sector of the Kazakh Branch of the Academy of Science of USSR began soil-ameliorative researches in Dzhezkazganskii raion and organized there an experiment station for the development of efficient methods for bringing under cultivation and irrigation desert-steppe areas and growing cultivated plants so as to cover the lands with green vegetation and create a vegetable-potato base for industrial centers.

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Experiments have shown that, notwithstanding the bleak natural conditions of the raion of Bolshoi Dzhezkazgan, it is quite possible here to grow almost all agricultural crops, trees and bushes.

The methods for irrigation and for growing the agricultural crops, trees and bushes, which were developed by the Dzhezkazganskaia Experiment Station - now a Research Base of the Academy of Science of Kaz SSR - began to take root in production almost immediately. In the region of Bolshoi Dzhez- [Begin p.44] Kazgan branch-farms were established and plantings of a new city with verdure were begun. But this was done on a limited scale and was far from answering the requirements of a swiftly growing industrial center.

Through the researches of the Institute of Soil Science in Dzhezkazganskii raion it was established, of late, that between the rivers Kengir and Dzhesda, nearer to their junction, 10-12 Km below the Kengirskii water reservoir, there is a promising area for irrigation and for the organization of extensive fruit-vegetable farming. The total area of this region is about 5,000 ha, from which, for the first round of bringing the land under cultivation, about 1,500 ha could be chosen; they would be uniform in the character of the soil, most suitable for irrigation, and not requiring any special amelioration. Irrigation of this area can be conducted by the gravity flow, by means of obtaining water from the large Kengirskii reservoir. At full control of the flow from the river Kengir, the large Kengirskii reservoir, according to the latest calcualtions, will have several tens of millions of cubic m of reserve water, part of which can be utilized for irrigation without any loss to the industrial enterprises.

Results of many years of research, which was conducted by the Soil Institute in the regions of Bolshoi Dzhezkazgan made it possible for the Government to provide for the construction, in 1952-1955, of the Kengirskaia irrigation system and for th organization in the raion of Dzhezkazgan

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of extensive fruit-vegetable farming on an area of 1,500 ha, utilizing the water from the Kengirskii water reservoir.

Unfortunately, certain organizations which were entrusted with the realization of the Government's resolution, did not meet their obligation to organize fruit-vegetable farming in the Dzhezkazgan raion and it has not been developed yet.

Thus, the two big and important works, which were accomplished by the Institute in past years remained unfinished: the oblasts map of Kazakhstan were not published through the Institute's fault and the results of soil-ameliorative research in Bol'shoi Dzhezkazgan raion were not realized through the fault of tother organizations.

Of late the Soil Science Institute conducted soil-geographical and soil-ameliorative researches of separate territories in accordance with public economy problems of the Republic.

The Institute started compiling soil maps of separate oblasts and raions of Kazakhstan, which must serve as a scientific basis for a precise tabulation and for a qualitative characteristic of lands in oblasts by raions.

Up to the present time soil maps were compiled for: Alma-Atinskaia oblast', for 10 raions of East---Kazakhstanskaia oblast', territories along the right bank of the Ural river, for the East-Kazakhstanskaia and Gur'evskaia oblasts and for the lowlands of the river Ili. More detailed maps were compiled for the Karagandinskii and Dzhezkazganskii industrial raions, for the lowlands of Emba river and for three raions of Alma-Atinskaia oblast'. The soil map for the North-Kazakhstanskaia oblast' requires yet considerable work before it is finished.

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The finished maps, with the explanation text and the agroproduction characteristics of soils, were turned over to the appropriate organizations for practical utilization.

Of late the Institute also conducted soil-ameliorative research for territories which were newly brought under cultivation for irrigation. [Begin p.46] A survey-soil map of the territory, which is serviced by Kzyl-Ordinskaia dam, was compiled together with Kzyl-Ordinskaia Scientific Base of the Academy of Science of KazSSR; sections which should be the first broughts under cultivation were preliminarily marked out, the water-physical properties and the salt content of the soil were studied; materials were collected, which were needed for the soil-ameliorating regionalizing of the territory, as well as for the agro-productive characteristicsof the soil.

On the assignment of "Lengiprovodkhoz", the Institute in 1951-1952 has compiled a soil map of the Caspian Sea region lowlands along the right bank of the Ural river. Simultaneously wer conducted studies of water-physical characteristics and of the salt condition of the soils. In addition to this a map was compiled for soil-ameliorated regions of the examined territory, and tabulation of lands, according to ameliorative groups, was accomplished. All the materials were passed on to "Lengiprovodkhoz" and utilized by them for the development of a plan for methods for irrigation and supplying with water the lowlands of the Caspian Sea. Results of this extensive work will be summarized, in 1954, together with those of the Soil Institute of the Academy of Science of USSR, and will be published in 1955 as a an open monograph on soils in the Caspian Sea lowlands. Part of the data is now being prepared for publication in the Works of the Institute.

In 1952 a study of water-physical properties of certain localities, which were marked for cultivation, were conducted as also was the organization of branch-farms around Karaganda.

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In 1953 the Institute continued the examinations of soils in the Karaganda industrial region and compiled soil maps for the newly investigated territories. This research was conducted in conjunction with a proposed passage of water from the river Irtysh for irrigation and supplying with water of the Central Kazakhstan. All the data from research will be summarized in 1954 and passed over to the proper organizations.

In 1952-1953 the Institute conducted soil observations in the lowlands of the river Emba in conjunction with a project for construction of Aral-Tiubinskii water reservoir on the river Emba for irrigation of its estuary and a development of a fodder base for cattle breeding. A soil map was compiled for the territory serviced by the Aral-Tiubinskii water reservoir; research was conducted of soil complexes of those sections which require irrigation. Data of research were handed over, in 1952, to the Gur'evskii Oblvodkhoz [Oblast' Water Department] for utilization when preparing the plan for irrigation of the territory.

The above cited soil-geographic and soil-ameliorative research, together with the compiling of soil maps, widened our knowledge and defined more accurately the ideas of soil scientists about the zonal distribution and geographic-genetic peculiarities of the soil of separate raions of Kazakhstan.

The large amount of the new factual material, which was collected during the last few years, makes it possible to make more accurate the nomenclature of soils and permits a development of a classification of soils in Kazakhstan, which is correct both in a scientific and practical respect. During the process of research methods for compiling soil maps, were made more precise, depending on their designation and scale.

Simultaneously with soil-geographical and soil-ameliorative research the Institute conducted routine and experimental research on problems for the

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increase of the fertility of the soils; studied the processes of soil formation and the genesis of the soils; microbiological [Begin p.46] processes in the soil and dynamics of the elements of fertility of soils in Kazakhstan.

Observations were made of processes of weathering and of formation of primary soils in various vertical belts of Tian-Shan, of processes of primary soil formations on granites of Central Kazakhstan, in mountain-meadow and mountain-forest belts of Kazakhskii Altai; of contours of agglomeration of amorphous silica in desert-steppe soils of Central Kazakhstan, of the composition of the organic substance of the basic types of soils in Kazakhstan; we observed the role of earthworms in the processes of soil formation on Altai and their importance in the formation of the natural fertility of the soil. Studies of dynamics of elements of fertility of the soil were conducted in the fields of grass crop rotations.

Microbiological processes in the soils of Kazakhstan have been studied and are now studied with the aim of establishing the character of interrelations among the soil microflora, the soil and the higher plants, and the effect of the soil microorganisms eon the dynamics of the fertility of the soil under conditions both natural and cultivated.

All this research was directed for developing scientific principles for efficient utilization, and for the increase in the fertility of the soils on the basis of studies of conditions of the formation and development of the natural fertility of the soil.

Results of these researches were given in detail in reports at a recent Scientific Conference on results and problems of studies of Kazakhstan soils. The Conference noted the especially great scientific and practical meaning of the work on studies of dynamics of the elements of the fertility of the soil in the fields of the grass crop rotations, which were conducted

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by the Institute in Akmolinskaia and Alma-Atinskaia oblasts.

Here I shall stop only on one of the effective and practically important researches of the Branch of Microbiology of Soils in the Institute on the development of methods for the preparation and utilization of local bacterial fertilizers for agricultural crops. This work is already giving practical results.

Experiments, which were conducted during 2 years on the fields of kolkhozes in Shortadinskii raion, Akmolinskaia oblast', and in Kaskelenskii raion, Alma-Atinskaia oblast', have shown that the use of azotobacterin and of phosphoro-bacterin, which was prepared by the laboratory of the Institute from local strains of soil bacteria, gives an increase in the yield of grain crops of 7 to 47% without watering, and up to 80% with watering; of perennial grasses - from 19 to 57% with watering. Good results were obtained after the introduction of bacterial fertilizers under vegetable crops and potatoes.

In 1953 the Institute prepared and distributed azotobacterin and phosphoro-bacterin to other regions of the Republic for an area of 570 ha. Data for calculation of the yield in 1953 confirm the effectiveness of local bacterial fertilizers under production conditions.

For instance, in the kolkhoz "im. Molotova" in Alma-Atinskaia oblast', on light chestnut soils without watering, bacterial fertilizers gave an increase in yield from 20 to 32%; in kolkhoz "im. Kominterna" on dark chestnut soils - from 7 to 29%; in kolkhoz "im. 1 Maia" on irrigated sierozems - from 37 to 87%. In kolkhoz "im. Zhdanova" in Shortadinskii raion, Akmolinskaia oblast', on low-humus chernozems without watering, joint introduction of azotobacterin and of phosphoro-bacterin gave an increase in yield from 42 to 47%, and this with considerably smaller expenditures [Begin p.47] of labor and outlay per one ha compared to other fertilizers.

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At the beginning of 1954 recommendations on preparation and use of bacterial fertilizers for different agricultural crops will be prepared and passed over to the Ministry of Agriculture and of Provision of KazSSR. The Institute will continue work on observations and on making the methods more precise for preparation and utilization of bacterial fertilizers, as well as to check their effectiveness on the fields of kolkhozes in Kaskelenskii raion Alma-Atinskaia oblast'.

In the light of decisions of the September Plenum of TsK KPSS the research of the Institute on bacterial fertilizers merits a serious attention. In his report at the Plenum, N. S. Khrushchev spoke about the necessity of a wide utilization of bacterial fertilizers. This research, which is connected with the latest recommendations of the Academician, T. D. Lysenko, about the soil feeding of plants, must be extended. It is necessary to organize in Kazakhstan a factory for production of bacterial fertilizers and for providing them to the kolkhozes and sovkhozes of the Republic.

These are the basic results of the work of the Soil Institute of the Academy of Science of Kazakhskaia SSR on the observation of Kazakhstan soils for the last few years.

Great and practically very important research of soils in lowlands of the river Syr-Dar'ia was accomplished by Kzyl-Ordinskaia Scientific Base of the Academy of Science of KazSSR. It conducted detailed soil and hydrogeological research in the lowlands of the river Syr-Daria and of northern Kyzyl-Kums on an area over 10 mln ha. Data of this research are utilized by the planning organizations as a foundation for the engineering-ameliorative measures for the economic utilization in the northern regions of Kzyl-Ordinskaia oblast'. The shaping and preparation for publication of monographs on soil-ameliorative observations in the estuary plains of Syr-Dar'a river and in the northern Kyzyl)kums is being brought to an end.

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This same Base developed, and prepared for utilization, an agrocomplex which guarantees a fast utilization of the rice-grass crop rotations with a rice yield not lower than 50 c/ha. The basic measure for the introduced agrocomplex is a method of deep stirring up of the soil with a chisel-cultivator.

Agromethods for utilization of solonchaks under rice, without any previous flushing were developed and offered to the producers. Utilization of the developed agromethod permitted a brigade "Geroia Sotsialisticheskogo Truda t. Tsoi" from the kolkhoz "Kantonskaia Kommuna" to obtain a yield of rice over 35 c/ha on an area of 100 ha. Previously such lands (solonchaks) were thrown out from the fields of crop rotations.

The Soil Section of the Gur'evskaia Scientific Base of the Academy conducts research on development of methods for amelioration and for the increase of fertility of soils of territories adjacent to the city of Gur'ev, and in the region of the Aral-Tiubinskii water reservoir in the lowlands of the river Emba.

Researches, which are very important in a scientific and practical respect, are conducted by the Soil Section of the Agricultural Institute of the Kazakhskii Branch of VASKhNIL, in particular, studies of cultivated-genetic forms of the utilized soils, the stationary and experimental research on studies of dynamics of basic characteristics and of elements of the fertility of the soil in the fields of the grass crop rotations. This last is conducted in conjunction with the Section of Microbiology of Soils of the Soil Institute of AN KazSSR on Shortandinskaia Experiment Station of the Institute of Agriculture. [Begin p.48].

When analyzing the present state of soil science in Kazakhstan we must evaluate objectively and correctly the achievements and the shortcomings in

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the work of soil scientists so as to accurately determine our current problems and ways for the further development of the soil science. In soil science, as in many other branches of science, it is necessary to develop a healthy criticism but support the leading opinions.

The lagging of the agricultural science ~~from~~ in the demands of the kolkhoz and sovkhoz production, which was pointed out in the resolutions of the September Plenum of TsK KPSS, refers also to the Soil Institute of AN KazSSR. The Institute helps the kolkhozes very little, as also the MTS [machine-tractor stations], and sovkhozes of Kazakhstan in the improvement of agriculture and in the increase of the yielding capacity of agricultural crops. In spite of the fact, that the Institute has done considerable research in studying the soils, in the tabulation and characteristics of land resources of Kazakhstan, in the work of the Institute there are substantial deficiencies in the solving of the main problem of soil science - development of scientific foundations for the basic improvement of natural conditions of the soil fertility, of effective utilization, and increase of fertility of Kazakhstan soils.

What are the reasons for the soil science's falling behind the demands of the kolkhoz and sovkhoz production?

The reasons are of twofold order: objective and subjective:

The reasons of the objective order consist of insufficient number of soil scientists in Kazakhstan. Kazakhstan occupies a territory of 2754 thousand sq. km. This is more than the territory of 14 allied republics put together, excluding the RSFSR; 32 times greater than Azerbaijan and 92 times larger, than the territory of Armenia. Only in a single Dzhezkazganskii raion of Karagandinskaia oblast' one can allocate three republics equal in territory to Armenia. But in Azerbaijan and in Armenia there are many more soil scientists than in Kazakhstan.

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This simple arithmetical comparison speaks about many things. First of all it points to the great rift existing in Kazakhstan between the need of what must be accomplished by the soil scientists, and the possibility - how to accomplish it in practice. The Institute alone cannot adequately and in good time solve all the problems of the soil science.

Shortage of soil scientists does not permit the Institute to unfold the work of compiling medium-scale and large-scale soil maps, needed for practical purposes. On the other hand, compiling of large-scale soil maps for farming purposes is not a direct problem of the Soil Institute of the Academy, but as yet we must put up with it. A large volume of territorial research does not permit us to set our soil scientists free for deeper observations in order to increase the fertility of soils in separate regions.

A practical conclusion offers itself from the above said: one must multiply the number of soil scientists in Kazakhstan according to the problems and requirements of soil science. For this purpose one needs to organize one single Department of Soil Science in the Ministry of Agriculture, and there should be a staff of soil scientists in every MTS and every sovkhoz.

The Soil Institute of the Academy of Science of Kazakh SSR and the Institute of Agriculture of the Kazakh Branch of VASKhNIL must carry out a systematic supervision of the work of local soil scientists on compiling large-scale soil maps of their raions and kolkhozes, on developing [Begin p.49] practical measures for the increase of the fertility of the soil on their sections and on the summarizing of the experiences of the leaders in socialistic agriculture.

In order to provide a sufficient number of soil scientists for all the agricultural organization, and scientific institutions, one needs to in-

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crease the contingent of students in soil science in the higher institutes of learning in the Republic and give them a full agricultural education.

Further on, it is necessary to change the cool attitude shown by agricultural organizations towards the specialists - soil scientists, so as to develop in them a feeling of professional pride, which matter was pointed out by Comrade N. S. Khrushchev in his report at the September Plenum of TsK KPSS, when he spoke about the correct employment of specialists in agriculture.

The lagging in theoretical summarizing of the extensive and valuable factual data, collected by the Institute is connected to the overloading of our soil scientists with field observations and financial processing of materials on compilation of soil maps for special regions in the vast territory of our Republic. The Institute has not as yet compiled a large and summarizing monograph about the soils of Kazakhstan, as a whole, as it is already done by our neighbors for Uzbekistan.

Nevertheless, as far as it is possible, the collective of the Institute endeavored and still tries to develop a theoretical thought and to push the soil science ahead in the Republic. During the full time of its operation the Institute has published eight issues of its works. At the present time two volumes of the Institute's work on soils in Caspian lowlands and in industrial regions of Central Kazakhstan have been prepared for publication. A large monograph about the role of earthworms in the processes of soil formation and of creation of the natural fertility of the soil has now been completed.

Besides the above cited difficulties which stem from a large volume of work and insuffícent number of soil scientists, there are other reasons for

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falling behind in soil science, which depend on the soil scientists themselves.

To the number of such reasons first of all refers the fact that many of our soil scientists do not know agronomy and do not try to master it in that measure in which it is needed by the soil scientists in their scientific and practical work. They study the soil apart from the life of plants. Our soil scientists know that for an increase in fertility of the soil it is necessary to develop a structure, to accumulate organic matter and moisture in the soil, and so on. But how to do this in separate specific cases, exactly which agrotechnical, ameliorative, or other measures can provide better conditions for the life of plants, about these matters many soil scientists have only a dim notion. We often speak about the amelioration, about control of salinization and swampishness, and write, that washing and drainage, as well as a correct system of watering are the preventive measures for salinisation of soil. But if the washing and drainage can be accomplished, ~~and~~ or what a correct system, under the given circumstances should be, we keep silent about this? In our scientific reports one often meets a general conclusion that for an increase in fertility of such soils it is necessary to introduce grass crop rotations. Certain soil scientists think that there will be no mistake, if they write: it is necessary to utilize grassland agriculture. Certainly, there is no mistake there, but neither is there any profit from such a general discussion.

All this tells us, that our soil scientists have not as yet sufficiently understood the principle of a production approach to the studies of soils. We often study the soils of separate regions apart from production-economics problems of these regions, taking nointerest in the direction taken by and the plans for the future of the kolkhozes and sovkhozes on whose territory

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we are conducting [Being p.50] the research. Many soil scientists also work independently of other agricultural specialists of the oblast' and raion. In consequence of this the results of very useful research of soil scientists in many cases do not find any application in practice, or are very slowly introduced into production.

In the future it is necessary to conduct a series of measures as a considerable supplement in agricultural education of our soil scientists, to organize special seminars, and, if needed, also practical studies in agronomy, especially on general agriculture. It is necessary to require of soil scientists that during their field observations they would become locally acquainted with the economy of kolkhozes and sovkhozes, that they acquire good understanding of the agrotechnical methods used there and learn what is the direction for future development of these farms. Only under these conditions can a soil scientist give practical help to the kolkhozes, to MTS, or sovkhozes by suggesting certain improvements in agriculture and raising the yielding capacity of agricultural crops. Without such a production approach to the studies of soils we cannot further successfully develop soil science in Kazakhstan.

One of the substantial shortcomings in the work of Kazakhstan's soil scientists is the poor propaganda of the achievements of our native soil science and about the results of their own research. The specialists and practitioners in agriculture know us very little, and we are only slightly acquainted with the experience of the leaders of socialistic agriculture. In the absence of a close contact with the specialists and leaders in agriculture, many of them treat the scientific investigations of soil scientists very sceptically. Our soil maps sometimes do not find any application in practice not because they are bad, but because we confine ourselves by just

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passing them over to the appropriate organizations and are little interested how they will be utilized. In our explantation notes accompanying the soil maps we do not show the production capacity of the soils, which are shown on the map.

Many very valuable and useful works of soil scientists in Kazakhstan take a long time before leaving the walls of scientific institutions. For instance, the Soil Science Section of the Institute of Kaz-branch of VASKhNIL has a long time ago compiled a map of lands of all the oblasts of Kazakhstan on which the interpretation was done according to a quite new principle as well as the agro-productive capacity of the soils where different types of agriculture are shown in proper zones, where the areas of lands are tabulated according to oblast, by raions; where their qualitative characteristics are given together with the zonal agrotechnicque. And yet very few specialists in the city of Alma-Ata know about this work. The chief executor of these maps, the superintendent of the Soil Science Branch of the Kazakhskii Institute of Agriculture Comrade S. P. Matusevich, did not as yet appear in public with a report about this work before a large audience of specialists in agriculture, and not even before the Scientific Convention of Soil Scientists of Kazakhstan, which only recently took place.

This example describes how we, the soil scientists, ourselves hamper the implantation into production of results of our own research fearing that may be something might happen. We should not forget that practice is the criterion of verity; we must test more boldly the accuracy of our scientific conclusions under production conditions.

One of the serious reasons for lagging in the development of problems of soil fertility not only in Kazakhstan, but also in other allied republics is the survival of a one-sided, purely theoretical trend [Begin p.61] in soil

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science. The supporters of this trend try to study the soil solely as a natural body, independently of its meaning to agriculture. Certain of them try, in every way, to discredit the progressive sides of the teachings of Academician V. R. Williams, taking hold of his isolated mistakes.

As Academician I. V. Tiurin correctly emphasized in his article "On problems of the Soviet Soil Scientist" ("Pochvovedenie, no. 9, 1953) instead of a creative development of the progressive sides of our native soil science introduced by the coryphaei, V. V. Dokuchaev, P. A. Kostychevaand V. R. Williams, a certain part of soil scientists of the Union displays a dogmatism, which is expressed in an unconditional acknowledgment of all, even of disputable and erroneous,views and conditions of some authors, and in a not less sharp negative attitude towards all the works of other; even great, scientists.

Such a dogmatism in the opinions is to be found also in individual Kazakhstan soil scientists.

The newspaper "Kazakhstanskaia Pravda", at the gbeginning of 1953, pointed out quite correctly a presence in the Soil Institute of the Academy of Science of Kazakh SSR, of some outdated points of view, which were revealed in verbal and in published public addresses of a member-correspondent of the Academy of Science of the Kazakh SSR, Professor A. I. Bezsonov, and of a a Candidate of Agricultural Science, A. M. Durasov.

The basic error of A. I. Bessonov is in his attempt to tear the Soviet Soil Science away from the socialistic agriculture,and in the non-acceptance of the newest achievements in the Soviet Soil Science, particularly of the progressive sides of the teaching of the Academician V. R. Williams. A. I. Bezsonov erroneously thinks that after V. V. Dokuchaev soil science did not progress, but even declined. The Presidium of the Academy of Science of Kazakh SSR, the Bureau of the Section of Biological Sciences and the Academic Board of the Soil Institute found the criticism of the "Kazakhskaia Pravda"

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This basic part, the healthy nucleus, of the collective body of the Institute of Soil Science accepted the criticism of the Republic's party press and the decision of the Presidium of the Academy about the work of the Institute and made appropriate conclusions for their scientific and practical work. The collective body of the Institute developed a business criticism and a self-criticism in its scientific work; organized a creative exchange of opinions on theoretical problems in soil science; attracted young specialists-soil scientists and effected a proper arrangement of personnel according to sections. The scientific subjects which were specified in the plan for 1953 basically were all accomplished.

Yet, individual soil scientists up to the present time continue to defend their erroneous points of view, not agreeing with their criticism on the pages of "Kazakhskaia Pravda". They accept the proper criticism about themselves as a display of dogmatism.

The first Scientific Conference of the Academy on the results and problems of study of soils in Kazakh SSR, which ran through 16-19 December, proved to be an important event in the life of the Institute. In the work of the Conference besides the Kazakh soil scientists took active part, scientists from Moscow, Uzbek, Kirghiz and Siberia, scientists from our Academy and other scientific institution of the Republic. Unfortunately, there were no representatives from the Ministry of Agriculture, nor were there many agriculturists from around the country.

20 scientific reports were presented and discussed during the conference. Especially valuable for us were the sapid reports of our [Begin p.52] guests - Professors K. P. Gorshenin (Omsk), S. N. Ryzhov and M. A. Pankov (Tashkent), Candidate of Science G. I. Roichenko (Frunze), and others.

Very helpful and interesting were the appearances at the Conference of

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the Chief of the Department of the Organization of Land Exploitation, from the Ministry of Agriculture of KazSSR, V. A. Sheremet'ev, of the agriculturist of Illiiskaia MTS, Comrade Manuilova, and of the coworker of Alma-Atinskaia Government Selection Station, Comrade Boiarovich.

The Conference pointed out that the Institute of Soil Science accomplished a considerable work in the field of study of soils, of the characteristic of land resources, and in the treatment of problems for the increase of fertility in Kazakhstan. The research of Kazakh soil scientists enriched the soil science with new data; the results of many of their researches find practical application in agriculture of the Republic.

The Conference also noted the substantial deficiencies which were present in the work of the Institute and pointed out that the basic efforts of the collective body should be directed to the development of scientific principles for the improvement of socialistic agriculture and of the fertility of Kazakhstan soils.

Thus, the Scientific Conference on the results and problems of study of soils in Kazakhstan has played its positive role; it gave a push to a further development of the creative thought of the collective body of the Institute and strengthened the confidence of young scientific coworkers of the Institute in their own powers and abilities.

Yet, one should note that the results of the Scientific Conference of Soil Scientists did not satisfy individual soil scientists which were of a sceptical frame of mind. In particular, Candidate of Geographical Science, S. I. Sokolov, was not satisfied with the high theoretical contents of reports at the Conference, in which there was no mention about the "dogmatism" in the teachings of the Academician V. R. Williams and in the opinions of his followers, which fact does, in the opinion of S. I. Sokolov, hamper the

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further development of Soviet soil science. S. I. Sokolov's report on the subject of "Modern state and future development of problems of classification and of systematics of Kazakhstan soils" did not satisfy the members of the Conference. All the report contained was a criticism of the modern state of affairs, but the members of the Conference did not hear the lecturer express his own opinion about the further prospects for the development of soil science.

The Academic Board of the Institute of Soil Science discussed the results of the first Scientific Conference of Kazakhstan Soil Scientists and adapted a resolution to prepare the works of the Conference for publication.

In the light of resolutions of the XIXth Convention of the Party and of the September Plenum of TSK KPSS, the Soil Institute of AN KazSSR must overcome its lagging behind the demands of the socialistic agriculture. The basic effort of the Institute's collective body in the future must be directed to the development of scientific principles for improvements in agriculture and in fertility of Kazakhstan's soils. Moreover one should pay special attention to the following:

a) bring to light the basic elements, which determine the fertility of soils under specific geographical and economic conditions;

b) to study the dynamics of elements of fertility of soils in the fields of grass crop rotations in order to find a scientific basis for separate types of crop rotations;

c) development of methods for the creation of a cultivated plowed layer under different soil-climatic conditions.

The Institute must continue its soil-geographical researches [Begin p.53] with the compilation of medium-scale soil maps; in the first place for basic regions of non-irrigated and of irrigated agriculture, as well

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as to widen the soil-ameliorative research in the most important territories and of those which were newly brought under cultivation; also to develop methods for utilization of solonchak and of salinized soils, and to increase the fertility of irrigated lands.

On the basis of all available data, it is necessary to work out principles for genetic and production classification of soils in Kazakhstan, as well as to develp methods for compiling large-scale soil maps, in order to help the local specialists to compile such maps by themselves.

On the basis of a creative utilization of the results of scientific-practical researches we must develop a treatment of theoretical problems of soil science, without breaking away from solutions of practical problems for the socialistic agriculture. Treatment of problems of genesis, of productive-genetic classification of soils, of theoretical foundations for the most important measures for the increase of fertility of soils must be conducted by taking into consideration the leading role of biological factors of soil formation and the productive activity of man. In the process of treatment of these problems we must improve the existing methods and adapt the newest methods for soil research.

In order to carry out our researches on a high principled level, we must get hold of the Marxist-Lenin dialectical method - the only scientific method of learning and of the revolutionary transformation of the world.

The Soil Institute of AN KazSSR must establish a close link with scientific-research institutions of the Republic, which work in the field of soil science and agriculture, with the Soil Institute of the Academy of Science of USSR, as well as with the soil institutions of Academies of the allied republics, of Branches of the Academy of Science of USSR and of neighbouring oblasts' in order to coordinate the plans for scientific-research work and

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mutual help.

The timely and qualitative accomplishment of the urgent problems which were set before us requires training of highly qualified soils scientists - Candidates and Doctors of Science with a wide agricultural education; this being the deciding factor for the future growth in the numbers of soil scientists in Kazakhstan. Although our scientific cadres have a great experience and a record of practical works, they attend to their duties pretty well, and also solve important problems in soil science of Kazakhstan, greater demands must be made of them in conformity with those large and responsible problems which were put before Soviet soil scientists by the directives of the XIXth Convention of KPSS and the resolution of the September Plenum of TsK of KPSS.

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Potapov, A. N.

Mekhanizirovath zagruzku samoletov iadokhimikatami.

[Mechanizing the loading of airplanes with poison chemicals].

Zashchita Rastenii ot Vreditelei i Bolèznei, vol. 1, no. 6. p.27. Nov.-Dec. 1956. 421 21

(In Russian)

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The airplane was first employed in the control of agricultural pests in the year 1922.

More than three decades have passed since. During this time the use of airplanes in agriculture has increased notably. In 1956 tens of thousands of tons of poison chemicals were used in the control of pests and diseases of agricultural plants with the aid of aviation, yet, strange as it is, the loading of airplanes is still done by hand.

For a number of years, the question of developing an airplane loader has been brought up annually, but up to now the matter has not advanced beyond conversation: nothing real has been done either as regards the mechanization of loading, or as regards improvement of safeguards for workmen handling the loading of poison chemicals (overalls [kombinezony], spectacles, respirators).

In the first issue of the journal "Zashchita Rastenii ot Vreditelei i Boleznei", tovarishch Starostin, senior fellow of the GOSNII GVF [State Scientific-Research Institute (?) of the Civil Air Fleet] writes: to reduce the number of workmen and to improve the servicing of airplanes, it is necessary to organize permanent labor brigades at MTS [machine-tractor-

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stations] in proportion to the number of planes, and to mechanize the loading of airplanes with poison chemicals to the maximum".

In the second issue of the journal, tov. Sazonov, fellow of the Civil Air Fleet, writes: "Equipping airplanes with special apparatuses - mechanical loaders - would reduce by half the time consumed by this type of work". The question is, who prevents the development of the required mechanical loader? Who is to look into it as behooves a matter of State, if the GVF and its Institute will not do it?

The need for mechanized airplane loading is determined also by the fact that getting labor for airplane-chemical work on kolkhozes is becoming harder every year. The period for control of a series of pests that appear in vast numbers coincides with the time of hay mowing when every kolkhoznik is busy harvesting hay. The airplane PO-2 has to be serviced by 6 men, and the airplane AN-2 by 15. In addition, there have to be guards and transportation workers for the transfer of loads from the main base to the periphery. Where are so many workers to be found? Each kolkhoz must hire a group of several man, and this complicates the matter and delays the work.

Apart from this, the loading of airplanes with poison chemicals by hand is unsafe for the health of the workers, particularly so, since sanitary safeguards against poison chemicals are not perfect.

Overalls are made of a material that lets through readily pulverized poison chemicals (calcium arsenate, dusts of DDT and benzene hexachloride, thiophos [tiofos], vophatox [vofatoks], etc.). Hoods should be made of a compact material and should be close fitting.

Spectacles fit loosely, the glass soon falls out, and nothing is visible from the sides. Specteoles should be of the type of pilots', firm and with well set glasses.

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Respirators are of a very inferior quality and heavy. The filter is rapidly clogged up with pulverized chemicals and it becomes impossible to breath. Respirators must be light, must fit the face well, and must not let pulverized poisons through the filter.

The mechanical airplane loader must be light, sectional, transportable, universal, and its servicing should require a minimum number of workers. It must be designed for loading not only poison chemicals, but also fertilizers. The loader must be considered as airplane equipment.

Our aviation industry releases first-class airplanes which are admired by the whole world. Could it not develop mechanical loaders for airplanes designed for agricultural purposes? It certainly can and must, and within the shortest possible space of time. This is an urgent demand of a growing agricultural production.

City of Alma-Ata
[Kazakh SSR]

FROM THE EDITOR

In his article, tov. Potapov raises rightly the question of mechanizing the loading of airplanes with poison chemicals. That this question is of vital importance is witnessed by letters received at the editor's office. Thus, tov. Sushko, head of the Samarkand [Uzbek SSR] Oblast Detachment for Pest Control, writes:

"In our oblast airplanes of three makes are used for agricultural purposes: the AN-2, IAK-12 and PO-2A. In many cases freely flowing poisons are used. Yet, there is only one method for their loading in small canvas bags 20 kg each."

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At the Civil Air Fleet they forget that if the PO-2-A airplane is loaded with little bags containing 180-200 kg of flowing poisons, then the IaK-12 could take on 350, and the AN-2 - 1000 [kg]. This sort of organizing requires a large number of workers. If the uninterrupted work of the PO-2A airplane requires 6 loaders, then the AN-2 must have five times as many! The matter of loading the IaK-12 aiplane is even worse. These airplanes enter the service of agricultural aviation without steplatters which would help in climbing up to the neck of the tank. Such "mechanization" incurs extremely high expenditures, raises the cost of chemical aviation work, and decreases the efficiency of the planes. This situation in the adaptation of new aviation technics to agricultural production is becoming intolerable.

The editor is waiting for answers from interested organizations on the facts of the questions raised.

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(Conclusions and
literature)
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Razumovskaia, Z. G., and Mitiushova, N. M.

Vliianie aeratsii na razmnozhenie i okislitel'nuiu deiatel'nost' acetobacter suboxydans.

[Effect of aeration on multiplication and oxidizing activity of Acetobacter suboxydans].

Mikrobiologiia, vol. 24, no. 3, p.265-270.
May/June 1955. 448.3 M582

(In Russian)

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Conclusions (page 270)

1. Intensified aeration of the medium affects both the multiplication and the oxidizing activity of Acetobacter suboxydans.

2. The influence of intensified aeration on multiplication depends on the number of bacteria. When large numbers of bacteria (tens of millions in 1 ml) are introduced into the medium, the intensified aeration accelerates the multiplication already in the first few hours of the development of the culture; during a depth process the multiplication is completed in 14 hours, whereas during a surface process of cultivation even after 24 hours the number of bacteria does not reach the maximum. With a "small" seeding (tens of thousands of bacteria in 1 ml of medium) the influence of aeration produces an effect only when the number of bacteria increases to a considerable degree.

Thus, the problem of influence of aeration must be considered in connection with the numbers of bacteria in the medium.

3. Intensified aeration not only accelerates the multiplication, but also tells on the oxidizing activity of bacteria, increasing it both under

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conditions of the "large" seeding, as well as of the "small".

4. Observations have revealed a possibility to conduct a process of oxidation of sorbite to sorbose at a changing rate of the passage of air. During the initial period the speed of the flow of air through the medium can be considerably slower, than at the moment of mass increase in the numbers of microorganisms.

Leningradskii State University
in the name of A. A. Zhdanov

Received 12. XII. 1954.

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(in part)
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Volkov, S. M.; Zimin, L. S., Rudenko, D. K., and
Tupenevich, S. M.

Al'bom vreditelei i boleznei sel'skokhoziaistvennykh kul'tur nechernozemnoi polosy evropeiskoi chasti SSSR.

[Album of pests and diseases of farm crops in the non-Chernozem area of European USSR].

Moskva, Gosudarstvennoe Izdatel'stvo Sel'skokhoziaistvennoi Literatury, 1955, 486p. 423 V882

(In Russian)

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Chapter 3 (in full p.32-54)

CHEMICAL SUBSTANCES USED FOR THE CONTROL OF PESTS AND DISEASES OF FARM CROPS.

General Directions

In farming many chemical substances are used for the extermination of harmful insects, mites and ticks, slugs, mouselike rodents, as well as of pathogens of plant diseases (fungi, bacteria, viruses). These substances are produced by the chemical industry in a solid and liquid state. They are used in farming in dust form, in the form of solutions, suspensions and emulsions, aerosols (mist), as well as in the form of poison gases or vapors. As it was pointed out previously, they are used in different ways, such as dusting, spraying and gassing of plants or buildings (fumigation). Many chemicals are used for disinfection (treatment) of seeds or for the preparation of poisoned baits.

All the preparations, utilized in agriculture, basically are divided into two groups: substances, which are utilized to control harmful insects - insecticides, and substances, which are utilized to control the pathogens

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of diseases - fungicides.

Almost all the chemical substances, which are used for the control of pests or diseases of plants, are poisonous, to one or another degree, to men, animals, birds and plants; on these last ones they cause burns of the buds, flowers, leaves, fruits, stems and roots, or they reduce the germination power of seed material.

In connection with this, in practice it is necessary to utilize such a dosage of poison, which was determined by science and experiments, and which would affect negatively the pest or the pathogen, but would not produce any harmful effect on the plant and its organs.

Some preparations (copper sulfate, Paris green, and others), which in their pure state burn the plants are used in combination with lime, soda, soap and other substances, which neutralize the burning action of the poisons.

Often, for a simultaneous effect on pests and pathogens of diseases, combinations of these preparations are made, mixing insecticides together with fungicides (for instance, copper sulfate with Paris green, anabasine with sulfate, and so on).

The utilized poisons must satisfy definite requirements. In particular, dust poisons must be dry and ground fine, should not have any more moisture or admixtures than the established norms. Poisons, utilized for spraying, must dissolve well in water, and make stable emulsions which do not stratify. Those poisons are of greater value, which can be used in different ways (dusting, spraying, and so on) for the destruction of different pests and pathogens of plant diseases. [Begin p.33]

Spraying, dusting, fumigation, formation of mists (aerosols), disinfection and treatment of seeds are conducted with the aid of various apparatus and machines, such as - dusters, sprayers, generators, treatment machines and fumigators of different horsepower.

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A brief outline on how to use the poisons is given in chapter 2 of this book. More detailed data can be obtained from special literature and appropriate manuals on the protection of plants from pests and diseases.

CHEMICAL SUBSTANCES, UTILIZED FOR THE CONTROL OF PESTS AND DISEASES *

AB - a preparation of A. I. Borgart. A powder in blue-green, gray or dark-gray color. The active ingredients of this preparation are the basic copper sulfate and copper carbonate. The preparation contains 15-16% of copper and not more than 3% of moisture.

It is used for a dry treatment of seeds of non-scaly crops (rye, wheat and naked grain varieties of barley and oats). The norm of output is from 200 to 300g of the preparation to 1 c. [centner = 100 kg. = 220.46 lbs] of seeds. It is convenient because it can be used 5-6 months before planting time, and also for the seeds which are reserved for vernalization.

It is also utilized for dusting the tops of potatoes for the control of Phytophthora infestans and of "macrosporiosa" [early blight of potatoes], for dusting the seed potato tubers for the control of rhizoctonia (black scab), as well as for dusting or spraying of fruit-berry plantings to control scab and other diseases.

It must be kept in a dry, closed building.

Anabasine-sulfate. A dark oily liquid. Dissolves well in water. Contains 20-30% of the anabasine alkaloid. A strong poison, dangerous to man and animals: produces poisoning even if it gets on the skin. A dose of 0.05g is lethal.

It is used as a poison of contact (external) action. Its poisonous action is increased when anabasine-sulfate is added to mineral oil emulsions. To a water solution of anabasine-sulfate 3-5g of soap to 1 L. of solution

Footnote * For convenience all the chemicals, which are utilized for the con-

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are added. The preparation can be combined with copper sulfate and Paris green, but then no soap should be added.

It is widely used in the form of solutions for spraying fruit-berry plantings, vegetable crops, fodder root crops, plants of the mustard family left to run to seed, and so on for the control of aphids, bud moths, pyralids, thrips, Poduridae in hotbeds, pear psylla and apple sucker, Tetranychus urticae Koch., and other insects with a delicate covering on the body.

It is also utilized as anabadust in dusting. Anabadust is a combination of some filler (for instance, air-slaked lime, ground sulfur, sifted road-dust, and others) with anabasine-sulfate.

Anabadust is being prepared as a 6-10% combination in a seed treating machine PSP-0.5 or in a barrel, which is fitted for a dry treatment of seeds. The prepared mixture must be kept in a tight barrel, otherwise it looses its toxicity very quickly.

Calcium arsenate. It is a powder of a white or light gray color. It almost does not cake. Is very convenient for dusting the plants. It contains 38-42% arsenic pentoxide and not more than 1% moisture. It is poisonous to man and animals. It is a poison of intestinal [Begin p.34] (internal) action. It can cause slight burns on cultivated plants. Delicate plants (peaches and others) can be burned by this preparation very considerably.

It is most often used for dusting, now and then for spraying and for the preparation of poisoned baits. This preparation is used to spray technical crops, legumes, vegetables, forest plantings, shelterbelts and nurseries. Can be also utilized for the control of pests of floral plants.

It is used for treatment by spraying of fruit trees during the period of fruit bearing instead of the Paris green, which causes burns ("netting") on fruits.

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The dosage for the preparation is 8-10 kg/ha, and for the orchard 25-30 kg/ha, depending on the age and the density of the plantings.

Calcium arsenate is widely used on berry bushes for the control of saw flies and gooseberry measuring worm moths. This preparation can be combined with Bordeaux mixture, with sulfur, with solutions of nicotine and of anabasine-sulfate, with mineral oils. This preparation cannot be used for dusting radishes, turnips and other root crops and plants which are used for food.

Calcium arsenite (arsenide of calcium). A white or grayish heavy non-caking, dust-like powder. Burns the plants very strongly. Must contain not less than 62-72% of arsenic trioxide and not more than 2% moisture. It dissolves poorly in water. It is a strong poison for men and animals.

It is primarily utilized for dusting forest areas and shelterbelts for the control of caterpillars of silkworms, of leaf rollers, as well as other insects with chewing mouth organs. It is also used for dusting the wild growing plants for the control of Loxostege sticticalis L., of meadow cut-worm moths, mouselike rodents and for the preparation of baits for locusts, for Agrotis segetum, for larvae of the harmful Tipulidae.

Can also be used for spraying with an addition to the working solution of a double or triple amount of lime in proportion to the weight of the poison(for a decreased burning of plants).

Spraying of plants with this poison must be stopped 25-30 days before harvesting.

A dose for dusting vegetable and field crops is 5 kg/ha. For a better dusting ability calcium arsenite is mixed with chalk, lime, road dust, and so on in a proportion of four times more than of calcium arsenite.

Dose for forest dustings is 15-20 kg/ha.

Sodium arsenite (arsenide of sodium). A paste of black or dark-gray

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color with a content of about 52% of arsenic trioxide and 15-20% of moisture. It hardens into solid pieces after long storage in open or badly closed containers. It dissolves well in water. It burns the plants very strongly and for that reason is mostly used for the preparation of poisoned baits, and only rarely, in the form of a solution, is used for spraying the weeds to control caterpillars of the Phytometra gamma L., of Loxostege sticticalis L., of Agrotis segetum, of locusts, mouslike rodents and of other pests of agricultural plants, which are concentrated in the weeds.

For the preparation of poisoned baits from grains of rye, wheat, corn and from seeds of vegetable crops 70g of poison are dissolved in 1 L. of water; grains or seeds are soaked in this solution for 24 hours (corn seeds for 40 hours). If there is an urgency for the preparation of the bait, then the grains should be boiled in the solution for 40-50 minutes.

For baits made of bread crumbs, 100g of poison are mixed with 1 kg of crumbs. For moistening of pieces of bread 1 part of poison is taken for 30 parts of warm water, and the bread is soaked in this solution. When preparing [Begin p.35] a green bait, the sprouted greens (of oats, barley or other grains) are soaked with 0.1-0.12% solution of the preparation. One L. of solution is sufficient to moisten 1 kg of cuttings.

Sodium arsenite is sometimes used for spraying gooseberry bushes (8g of poison to 10 L. of water) for the control of the American parasitic fungus.

Bordeaux mixture. It is prepared from copper sulfate, lime and water. It is utilized for the extermination of pathogens of plant diseases. The properly prepared Bordeaux mixture is of a sky-blue color. An excess of copper sulfate in the mixture causes burns on plants. In such a mixture a litmus paper becomes red. During practical work the quality of Bordeaux mixture can be determined by an iron polished article (the blade of a knife,

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a nail, and so on): if the mixture is not prepared in a correct proportion, a red coating appears on the metal and shows an excess of copper sulfate in the mixture. Such a solution will burn the plants. Therefore lime milk is added to it in such proportions that no red coating appears on the metal when tested. Excess of lime in the Bordeaux mixture makes it of little effect.

Usually the mixture is used when it has 05-1% (even 2%) of copper sulfate with an equal, or one and one half, amount of lime. The solution of copper sulfate and the lime milk are prepared in separate utensils (wooden, clay, copper or glass) and then are poured together while mixing it very thoroughly. The liquid must be used the same day of its preparation. Very often to this mixture are added: Paris green, IBO [Lime-sulfur decoction], nicotine - or anabasine-sulfate for a simultaneous extermination of pathogens of diseases and of pests of plants.

Of late, the 3-5% Bordeaux mixture is being utilized for the spraying of fruit trees (a blue spraying).

Methyl bromide. It is obtained from sodium bromide, methyl alcohol and sulfuric acid. Methyl bromide is a gas, which liquefies at a temperature of 4.6° into a liquid with specific gravity 1.732. The specific gravity of the gaseous methyl bromide is 3.29. The mixture of its vapors with the air, at a presence in 1 m^3 of air of 535-570g of methyl bromide, ignites from a flame or an electric pspark. But in practical work methyl bromide is safe because such a concentration practically does not happen.

Solubility in water is 0.1%; is very soluble in alcohol, ether, oil, or other organic solvents. It is utilized as a fumigant for disinfecting different planting material, including strawberry (Fragaria vesca) for the control of Tarsonemus fragariae Zimm. In a gaseous form methyl bromide penetrates inside the treated materials very quickly, almost causing no trouble to the live tissues of the plants. In its liquid state it harms the

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Methyl bromide kills the mites in all their stages of development (the adult mite, the eggs, larvae and the nymph).

The absence of either smell or color is a disadvantage of this preparation, because that makes its vapors imperceptible even in concentrations which are dangerous to people, which can cause mishaps.

Methyl bromide is stored and transported in liquid form in iron barrels, steel cylinders, jars or glass ampules. Before bottling it is cooled in the course of 2-3 hours in boxes filled with ice and salt (10% of salt to the weight of ice). The bottling should be done by experienced people. This preparation is a very strong poison and is dangerous to men, animals and birds. Acetylene jet is used to determine the leakage of methyl bromide from the chamber where the fumigation of plants is conducted. [Begin p.36] In the presence of methyl bromide the flame of the jet becomes green, light blue or dark blue in color; and at a high concentration the flame goes out. If the acetylene flame is not available one can use instead the flame of a candle, or a lighter, or even a match.

Hexachlorane. Hexachlorane preparations are produced in various forms for the control of pests of agricultural plants: technical, dusts, and concentrated mineral oil emulsions of hexachlorane.

The basic name of hexachlorane is hexachlorocyclohexane (the abbreviation is GKhTsG).

It is obtained by passing chloride through boiling benzene in direct sunlight or under the action of rays from a quartz or mercury lamp.

The product is a white crystalline powder with a yellow tinge and an unpleasant smell.

It is almost insoluble in water, but dissolves well in mineral oil, benzene, kerosene, alcohol, dichlorethane, and other organic solvents.

Alkalis (lime water in particular) break down GKhTsG, that is why

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it should not be mixed with alkaline components.

Technical GKhTsG is a crystalline substance of a dirty white color and with a pungent smell of mold. It evaporates when heated. It dissolves well in organic solvents and is practically insoluble in water.

Dusts, mineral oil emulsions for spraying the plants, and mists (for the aerosol use) are prepared from technical GKhTsG.

Powder preparations - mixtures (dusts) of GKhTsG are the basic form for its utilization in farming for the control of pests of agricultural plants and external parasite's of animals. They usually contain 12% GKhTsG and a filler (talcum, kaolin, ashes from the electrical station, and so on). They are insoluble in water and in acids, they dissolve well in mineral oils, in dichlorethane and in many other organic solvents.

Dusts are prepared under industrial conditions by means of careful grinding and mixing of technical hexachlorane in special grinders. Doses of the preparation for dusting are 15-30 kg/ha, depending on the crop, age of the plant and density of the planting.

Besides the 12% dust of hexachlorane, a 25% dust is also prepared with a base of phosphorite meal or superphosphate to introduce into the soil for the control of soil-inhabiting pests.

Dusts of hexachlorane are more convenient to use, but are less effective than the mineral oil emulsions with an addition of GKhTsG because they do not adhere so well to the leaves and do not stick to them so good. Suspensions are prepared from kaolin dusts.

Hexachlorane preparations are used for the control of pests of fruit-berry plantings, vegetable, grain and grain-legume crops, clover seed plots, fodder root crops, granary pests, pests of shelterbelts, and others by means of dusting, spraying with suspensions, dusting the soil around the stalks

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of cabbage, of berry plots, dusting the seeds before planting and during the time of storage; for introduction into the soil before plowing or cultivation. Dusting the seeds with hexachlorane increases the germination and improves the development of plants.

The negative side of GKhTsG is its pungent unpleasant smell, which can affect the taste qualities of products. [Begin p.37].

Hexachlorane cannot be used for treating flowering plants, those with fruits, for cabbage since the moment of the formation of heads and for other crops which are eaten in a green form (cucumbers, lettuce, sourgrass, radishes, and others). Hexachlorane cannot be used for introduction into the soil under potato tubers and other tuber - root crops.

Hexachlorane loses its toxicity faster than DDT from the influence of sun's rays and high temperature. In 15 days it loses its toxicity by 50%. At a temperature of 50° after 3 days the toxicity of the preparation is lost altogether. Dispersed sunlight does not produce any noticeable influence on the change of toxicity of GKhTsG preparations.

The toxicity of GKhTsG decreases faster in emulsions than in dusts or suspensions.

Hexachlorane does not burn the plants in doses used in practice.

It is dangerous to some of the insects which are useful in farming, and especially to bees.

<u>Concentrate of the mineral oil emulsion with a toxic addition of GKhTsG.</u> This is a thick light brown liquid or paste; it contains 20% of the technical GKhTsG, 40% spindle oil and 40% emulsifier and water; dissolves well in water. Is prepared by the chemical industry and put out in iron barrels of 25-50 L. of cubic content.

Usually for spraying a 3% working emulsion sis prepared from the concentrate; for this purpose the concentrate is diluted with water (10-30g

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of concentrate per 1 L. of water).

Water of any hardness or temperature can be used. Emulsion is prepared in the same manner as the working emulsion of DDT.

The effect of mineral oil emulsion with a toxic addition of GKhTsG on men and animals is similar to that of the mineral oil emulsion of DDT.

It is used for spraying plants for the control of pests of different agricultural crops. Emulsion with GKhTsG has a specific persistent unpleasant odor, and that is the reason why it should not be used on trees and berry patches with fruits, and on plants which are used for food in their raw state; the emulsion can influence the taste qualities of the products.

Solutions of the technical GKhTsG in petroleum products for aerosols. In order to obtain aerosols a 4% solution of GKhTsG is prepared in diesel fuel, solar and green oil, or in kerosene.

For this purpose the needed amount of the solvent is poured into a barrel and the technical GKhTsG, which was ground to pieces of a size not more than 1 cm^3 is added to it. The solution is periodically stirred up to a full disappearance of lumps. In case of urgency in the preparation of the solution the oil is heated in an iron utensil up to 40-60° and the pieces of GKhTsG are poured into the warm oil. In order to prevent a fire, the oil is heated on a slow fire and far away from buildings. The technical GKhTsG is dissolved in the green oil to the amount of 15%.

When using warm solutions their concentration can be increased about 2 times, but then the average output of the solution must be correspondingly decreased.

During storage, especially at a raised concentration or low temperature, GKhTsG crystals separate out from the solution; in this case the solution should be heated to a full disappearance of crystals before use.

The dose of the working solution of GKhTsG is from 5 to 40 ml per 1 m^3

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of the premises depending on the quality of the hermetic condition of the premises, of the utilized oil and the kind of pest. [Begin p.38]

It is used for thecontrol of granary mites and of other pests of stored food products, as well as of the external parasites of animals and birds. 2 or 3 days after treatment of the premises with aerosols, the premises must be aired, all the fallen pests mmust be swept out, the floors, walls and feed boxes should be washed off with lye.

Solution of GKhTsG and DDT in petroleum products for aerosols. Mixed solutions are used for obtaining aerosols, that is GKhTsG and DDT, which are separately dissolved in diesel fuel, oils and kerosene and mixed together before utilization, so as to avoid the decomposition of these poisons. The separate solutions should be prepared only 1-2 days before utilization.

The technical GKhTsG is dissolved in diesel fuel, solar oil or kerosene in the amount of 40g per 1 L. of the solvent; DDT is dissolved in a similar solvent in the amount of 100g per 1 L.

When on account of low temperature or high concentration the crystals of GKhTsG or of DDT separate out from the solution, these solutions must be heated up to 50-60° in an iron container, far away from buildings.

A dose of the solution is 10-40 ml per 1 m^3 of the area.

Is highly effective for the control of granary pests.

Caterpillar glue. A thick viscous mass of a light to light brown color, with a resinous odor. It is prepared from resins, turpentine, rosin and coal tar by means of mixing in various proportions with flax or other oils and a following cooking.

The caterpillar glue must be stable; must not be dissolved by rain, must not run and dry out in the sun and must not solidify in cold weather. The chemical industry puts it out in barrels of 50-100 kg and in iron jars of 10-12 kg.

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This glue is used for glue "belts", which are applied to the trunks of the trees and to the heavy branches, in order to prevent the crowling into the crown from the earth (along the stem) fby the females of Operophtera brumata L., by various caterpillars, of Sciaphobus squalidus Gyll., and by other harmful insects.

Strips of thick paper, 5-10 cm wide, are used for the preparation of r rings; they are put around the trunk at the height of a man's breast and attached with a string. The glue is smeared over this paper.

The output of glue is about 10 kg per 1 ha of orchard.

The caterpillar glue can be prepared on the farm according to the following proportions:

1) 2 parts tar and 1 part flax oil mixed together and cooked over a low fire for 6 hours;

2) 10 kg of pine tar, 1.25 kg of rosin, 2 kg of pitch and 1.5 kg of vaseline are mixed together and cooked. If the glue dries out too fast a small quantity of oil should be added.

DDT. Preparation DDT is a shortened name for the oraorganic synthetic compound of dichlorodiphenyltrichloroethane.

The technical DDT is a crystalline substance of a grayish yellow color with a slighty fruity smell. It dissolves in mineral oils, in alcohol, benzene, kerosene, dichlorethane and in other organic solvents. It does not dissolve in water. It melts on fire and burns with a yellow flame; it melts in boiling water also.

DDT is a contact poison, which affects the nervous system; it also has the properties of intestinal poison. After the contact of the insect with the preparation, the extremities become paralysed, first of all (in about 20 minutes or somewhato longer); later on a full paralysis follows and the pest perishes.

DDT is usually used in a form of a 5% dust for the control of pests of

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agricultural plants; it is prepared in factories which use talcum/or clay as its base; also as suspensions (at the present time for the preparation of suspensions a dust containing 30% of DDT is put out); in [Begin p.39] the form of a solid substance for a toxic addition to the mineral oil emulsions, and in the form of aerosols.

Industry puts out technical DDT in drums, made of paper pulp, the dusts in heavy paper bags, emulsions and concentrates in barrels.

DDT is used for the control of many pests of fruit-berry plantings, of vegetable, grain and grain-legume crops, tubers, root crops, seed plots of clover, and others. A dose for a 5% DDT dust is 10-20 kg per 1 ha of field and vegetable crops, and 25-30 kg per 1 ha of the orchard.

Preplanting dusting with DDT dust of the seed material of grains, peas, clover, vegetable and fodder root crops effectively protects them, as well as the sprouts of these seeds, from damage by pests.

DDT does not burn the plants, it increases the germination of seeds and stimulates the growth of plants. Dusting the space under the floor of granaries is effective for the control of mites and other pests of stored food supplies.

DDT has very little effectiveness against mature caterpillars and against slugs.

DDT is a slowly acting poison; 1.5 mg of it can cause symptoms of poisoning, and 5-10g is a lethal dose for an adult man. It can enter the organism through the mouth, respiratory passage, or through the skin. The oil solutions are the most dangerous. Aqueous solutions are less dangerous. If preventive measures are taken (goggles, respirators and gauze bands with a cotton interlayer) then DDT is harmless in work. On account of its toxicity DDT dusting or spraying must be stopped 20-30 days before harvesting.

DDT is toxic to insects which are useful in farming, including the

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Mineral oil emulsion with a toxic addition of DDT is primarily utilized for spraying fruit-berry plantings against aphids, psylla, against Hyponameuta malinella Zell., leaf-roller moths, curculionidae, scale insects, and other garden pests. A working emulsion is prepared from the concentrated mineral oil emulsion (concentrate), which is prepared on the mills of the chemical industry or directly on the farm.

This preparation belongs to the number of slowly acting poisons. With a repeated use of small doses, the poison is accumulated in the organism and it causes poisoning. The work with DDT solutions is especially dangerous because they can be absorbed through the skin.

It can be used for pest control in a combination with Bordeaux mixture.

Concentrated mineral emulsion DDT, factory made. A thick yellow-gray liquid, contains 40% of spindle oil, 20% of technical DDT, 40% of emulsifier and water.

Concentrated mineral oil emulsion of DDT is prepared on the farms in different ways.

1. Technical DDT is dissolved in mineral oil in the amount of 6% of the weight of the oil. At low temperatures of the air, the oil with DDT is heated (up to 40-50°) in a cast iron kettle, stirring constantly. In order to avoid ignition of the oil during heating it is necessary to take precautionary measures (heat over a protected fire or over coals and away from buildings). DDT must be dissolved 1-2 days ahead of the spraying. After this 0.6 kg of unctuous clay [zhyrnaia glina] are dissolved in 0.5 L. of water until the consistency of heavy sour cream, and into the obtained solution, gradually, [Begin p.40] small portions of oil, with DDT dissolved in it, are added and the mixture is carefully stirred. If the oil ceases to mix, more water is added. When all the oil has been mixed with the unctuous clay and the mixture looks like a uniform fatty mass, the concentrate is then ready for the

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preparation of the working solution.

In a carefully prepared concentrate there should not be any traces of free oil. A concentrate thus obtained contains 50% of oil with DDT; 25% of unctuous clay and 25% of water.

2. A concentrate is prepared from 60% of oil (in which 6% of technical DDT was dissolved), 6% of unctuous clay and 34% of water.

This concentrate is prepared by putting the mixture through the spray nozzle of the sprayer. In practice it is done as follows. Into the tank of a sprayer (horse-motor or tractor) are poured 102 L. of water and 18 kg of unctuous clay are added; and the stirrer is immediately put into motion to mix the unctuous clay with the water. In 2-5 minutes, without stopping the work of the stirrer, 180 L. of oil, in which 6% of DDT were dissolved, are added.

The nozzles are put within the vent of the tank for mixing and the mixture is passed through the atomizers in the course of 20-30 minutes, after which the liquid is pumped through the nozzles into the barrels.

The properly prepared concentrates from unctuous clay have a uniform appearance without a trace of separated oil on the surface and mix well either with soft or hard water.

In case of stratification of the concentrate, of separation of the oil and an impossibility of a reestablishment of uniformity in the emulsion by stirring, it is restored by a repeated pumping over through the atomizers of the sprayer.

For the preparation of the working (1%) emulsion water is added to the concentrate in a proportion of: 10g of the factory made concentrate per 1 L. of water, or 2 kg of concentrate, prepared on the farm according to the 1st method, per 98 L. of water, or again 1.7 kg of concentrate, prepared according to the 2nd method, per 98.3 L. of water.

When preparing the working solution, water is gradually added to the

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concentrate is small portions, while stirring constantly until the time that the emulsion acquires a form of thin sour cream. After that the emulsion is poured into a barrel or directly into the sprayer (horsedrawn or tractor) and the required amount of water is poured in. Then the stirrer is put to work for 1-2 minutes, and, after mixing, it is ready for spraying.

For each filling of the sprayer, the emulsion in the barrel must be carefully stirred.

The working emulsion must be utilized the same day of its preparation, because after long standing a separation might occur.

Utilization of the separated emulsion is not tolerated because it produces burns on the plants.

1One per cent mineral oil emulsion with a toxic addition of DDT without the preparation of concentrates. It is prepared on farms which have horse-motor sprayers of OMP-A ("Pioner" type) or other sprayers which have stirrers.

It is recommended to use oil with DDT in a form of the so-called "tank mixture", which is a mechanical mixture of oil and water in the presence of a spreader (protein of blood).

The technique for the preparation of a 1% tank mixture of oil with contents of 0.06% DDT consists of the following. The tank of the sprayer is filled with 350 L. of water. 80g of blood protein are dissolved in a small amount of water (up to 0.2-0.3 L.) by slowly adding water to the protein and carefully rubbing it. After that the dissolved [Begin p.41] protein is poured into the tank of the sprayer. To each g of the blood protein 3g of unctuous clay are added; this improves the spreading and the moistening of the liquid. After that into the tank of the sprayer are poured 4 L. of oil, where 6% of DDT were dissolved, and the motor of the sprayer is switched on. By rotating the stirrers for one minute a uniform mixture of oil and water is obtained. After this, the tops are opened and the spraying begun.

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A combined liquid, consisting of oil with DDT and of the Bordeaux mixture can also be prepared by the method of tank mixture. In this case the blood protein can be excluded, as the Bordeaux mixture, which includes lime, assists in the uniform distribution of oil with DDT in the combined mixture.

For the preparation of the combined Bordeaux mixture and of oil with DDT the tank of the OMP-A sprayer is filled with the Bordeaux mixture, then the required amount of oil, with DDT dissolved in it, is added and after 1-2 minutes of stirring the spraying can be started.

Solution of the technical DDT for aerosols. For the obtaining of aerosols a 10% solution of DDT in diesel fuel, solar oil, or kerosene is made.

It is utilized for disinfection of granaries for the control of *Pediculoides ventricosus*, curculionidae, moths and other harmful insects and rodents.

It is highly effective for the control of the external parasites of domestic animals and birds (ticks, bird lice, and others).

Automobile generators (table 207) are used for disinfection of buildings by the aerosol method.

Preparation and utilization of DDT solution is the same as the hexachlorane solution.

Suspension of DDT dust. For the preparation of a suspension a DDT dust made with kaolin is used. A 2% suspension (20g of 5% dust of DDT per 1 L. of water) is utilized for spraying of fruit plantings, to control apple and cherry snout beetles; caterpillars of apple moths, pierid butterfly, browntail moths, and other pests.

Can be used in combination with Bordeaux mixture. A dose for the suspension in the orchard, when working with land apparatus, is 1000-1500 L./ha.

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When working with a DDT suspension only those sprayers can be utilized which have stirrers.

When spraying from airplanes suspensions of a somewhat greater concontration are used (100g of DDT dust per 1 L. of Bordeaux mixture). Output of the suspension consists then of 250 L./ha.

At the present time a 30% dust is put out for the preparation of suspensions; and suspensions are prepared of 0.2-0.3% concentration.

Dichloroethene (ethylene chloride). Dichloroethene (abbreviated DKhE) is a colorless liquid with a chloroform smell. Its vapors are 3.5 times heavier than air. It boils at 74-79°, its specific gravity is 1.225-1.260. It ignites with difficulty, burns with a green flame giving off smoke. At the beginning of burning it is easily extinguished with water, as water produces a film on top of dichloroethene. But during strong burning of dichloroethene extinguishing with water can cause an explosion. It ignites at a concentration of 200-600g and more per 1 m^3 of air. Is not soluble in water; dissolves in alcohol, carbon bisulfide, and others.

Dichloroethene is utilized as a fumigant and is used for disinsection of granaries in a concentration of 250-300g of poison per 1 m^3, in a hermetically closed building with an exposure of not less than 72 hours.

Packing sacks, railroad car shields, and so on are also disinfected at a concentration of 400-500g per 1 m^3 of air.

Is also utilized for the control of soil-inhabiting pests. [Begin p.42]

For a disinfection of empty buildings and of places under the floor, a combination of dichloroethene and of chloropicrin is utilized with doses of 74-83g of dichloroethene and 6-8g of chloropicrin per 1 m^3 of the area. For places under the floor 92-101g of dichloroethene and 8-9g of chloropicrin are taken.

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Caustic soda. It is a hard white substance. In the open air it combines with carbon dioxide and water vapors, changing into sodium bicarbonite, and after that into washing soda (sodium carbonate). The hard caustic soda is easily dissolved in water.

Caustic soda can often be brought in the form of 40-60% solutions, which are industrial wastes.

It corrodes cloth, leather, and so on. It is dangerous to man also; it produces burns on the body.

It is stored in tight, closed iron packings.

It is utilized for a moist disinfection of granaries, of storehouses, railroad cars in the form of a 10% solution, and for the disinfection of the floors as a 12-15% solution.

It produces a weak effect on beetles, as the hard chitinous covering of these insects protects them well from this preparation. It is highly-effective for the control of Pediculoides ventricosus.

Output of caustic soda for 1 m^2 of walls and ceiling is 60-60g, and of the floor 60-75g. Output of liquid is about 0.5 L. per 1 m^2 of the surface.

Green vitriol. Crystals of a green color, in the air they oxidize and become covered with a yellowish brown film. They dissolve well in water.

It is utilized to control diseases and pests of agricultural plants mainly by spraying trees and bushes when they are leafless (late in the fall or early in spring before the opening of buds).

Trees and bushes which are treated with green vitriol start blooming 10-15 days later, than the untreated ones.

3 or 4% solution of the green vitriol is utilized for the elimination of mosses and lichens on old fruit trees and berry bushes, as well as to

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control pear and apple scab, fruit rot, Exoascus pruni.

Solutions of green vitriol (40-80g of green vitriol per 1 L. of water) are effective against Limacidae when spraying the sprouts of winter crops in the fall; the spraying must be done at night when the slugs come out to feed, as the solution of the green vitriol has the property of a contact action.

It should be used without any lime admixture.

Green oil. This is a product of pyrogenous decompositon of petroleum. It is obtained after distillation of naphthalene oil. It does not dissolved in water. It is utilized only in the form of emulsion for a moist disinfestation of empty granaries and other storage buildings for the control of mites and other pests of food stuffs.

The preparation can also be used for disinfestation of hotbeds and hothouses for the control of Tetranychidae.

In order to prepare the condentrate of the emulsion one takes 70 parts of the green oil, 5-6 parts of unctuous clay and 25 parts of water and all this is carefully churned.

For the disinfection of buildings the solution is prepared by taking 30-50g of the concentrate per 1 L. of water.

Emulsions which are prepared with unctuous clay at the farm are less stable than those made from the factory concentrate; they soon separate and give a weaker effect in the control of pests of food stores, in hotbeds and hothouses. It is also utilized for aerosols.

Lime-sulfur decoction (ISO). It is a liquid of cherry-red color; it is prepared from ground lump sulfure, from sublimed sulfur and quick lime. For the preparation of the concentrated (mother) solution of ISO [Begin p.43] for each 1 L. of water 320g of sulfur and 160g of quick lime are taken. At first lime is slaked with a small quantityt of water, and into the hot sour

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cream-like mass sulfur is added, after this the rest of the water is poured in. The mixture of sulfur with lime is boiled on a slow fire about 60 minutes. As the liquid boils out water is added to the kettle so as to reestablish the original volume. The additions of water are stopped 15 minutes before the end of the liquid's cooking. One should not overcook the liquid because then it becomes green and burns the plants.

For spraying leafless trees one part of the concentrate is dissolved with 10 parts of water. For spraying trees which have leaves, 1 part of the concentrate is dissolved by 60 (during sunny weather) or by 25 parts of water (during cloudy weather). For the disinfection of hotbeds, hothouses, and granaries 1 part of the mother solution is dissolved in 10 parts of water; and for spraying of cucumbers for the control of Tetranychidae one part of concentrate is dissolved in 250-300 parts of water.

ISO has insecticidal and fungicidal properties. It is used for the control of aphids, scale insects, bud moths, psylla, measuring worm moths. It is also effective against scab, fruit rot, gooseberry and currant rusts, caused by some form of Puccinia.

ISO can be utilized in combination with copper sulfate, anabasine and nicotine-sulfates, but it cannot be mixed with mineral oil emulsions, soap or Paris green. In such combinations the solution produces heavy burns on plants.

Lime. Quich lime is in a form of white lumps. It is obtained by means of calcination of limestone at a temperature around 1200°. Under the action of moisture it is slaked and it becomes slaked lime.

In the calcined lime different admixtures are usually found (pebbles, non-calcined limestone, and others). When utilizing it in the work for the protection of plants this circumstance must be taken into consideration: large particles stop up the nozzles of sprayers.

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Air-slaked lime is obtained when a small amount of water is added to the quick lime; when more water is added a sour cream-like mass is obtained. A suspension (lime milk) is obtained with a further addition of water into this sour cream-like mass. For the protection of plants one should use only the freshly slaked lime.

The lime suspension is prepared by adding 1 L. of water to 200-250g of lime. It is utilized for whitewashing (spraying or coating) of trunks and of branches of fruit trees, for the disinfection of storehouses for fruits, vegetables, potatoes, grains as well as of hotbeds and hothouses at a dose of 0.5-1.0 L. per 1 m^2 of the treated area.

Air-slaked lime is utilized as filler for the preparation of various dusts, and in its pure form for the control of slugs. Lime is utilized for the preparation of the Bordeaux mixture and/of solutions of Paris green for the neutralization of the acid reaction of these solutions.

<u>Calcium hypochlorite mixture.</u> It is a dry white powder with a chloride smell. Calcium hypochlorite mixture is also called a bleaching lime or a bleaching powder. The standard bleaching powder contains 32-35% of active chloride.

When stored in the open air it strongly absorbs moisture and carbon dioxide and becomes a moist or even a watery mass. It decomposes quickly with a separation of chloride and of oxygen. That is why it is stored in tightly closed wooden barrels or iron drums.

It corrods the metals, especially copper. That is why in the building which is treated with the bleaching lime all the metallic articles must be painted with an oil paint or a solution of chalk, and after the treatment must be carefully washed, dried and coated with oil. [Begin p.44].

The bleaching lime destroys leather footwear, cloth and other articles and changes their color.

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It is utilized for disinfecting storage places for vegetables and potatoes (1-3 kg of lime per 100 L. of water), of fruit storage places (4% solution) hotbeds and hothouses (5-10% solution) as well as for disinfection of the soil in fruit tree nurseries for the control of bacterial cancer of the roots in a dose of 50-150g per 1 m^2 by means of introduction into the soil in a dry state.

Soda ash. Crystalline powder of white color. Dissolves well in water.

It is utilized in the form of solutions, which almost do not burn the plants; it can be sprayed on fully ripe fruits and vegetables and even on plants during blooming.

It is widely used for the control of American parasitic fungi on gooseberries and of Erisyphe oidium on grapes at a concentration of 5g per 1 L. of water with an addition for each 10 L. of liquid (for better adherence) of 1-2 spoons of sugar syrup or 12-18g of soap.

In a higher concentration it is quite effective against the spores of parasitic fungi (Erysiphaceae).

Carbolineum or coal-tar oil. Dark brown, oily, viscous liquid, with a strong tar odor. It is obtained during distillation of coal. It has fungicidal, insecticidal and bactericidal properties.

It is used chiefly for spraying fruit trees in the fall or in early spring in a form of a 6-10% emulsion for the control of scale insects, and aphids which overwinter on trees in the phase of eggs. Can be used against cabbage maggot, carrot rust fly and other flies as a frightening away medium.

Plants, which are used for food, should not be sprayed with carbolineum, because its strong smell can influence the taste qualities of the products.

In spring carbolineum is used for greasing tree wounds and also for

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the protection of wood from fungi damage.

Carbolineums with a greater specific gravity and with the most high boiling temperature are held to be the best. Those carbolineums are utilised for spraying, which emulsify well in water; as for coating the trees and for saturation of wood those are used which are heavier and cannot be emulsified.

Kerosene. The use of kerosene in its pure form, as an insecticide, is limited. It possesses high toxicity to animals, mites and mollusks; it also affects the plants destructively, burns the leaves, young shoots and buds.

It is useful for the extermination of eggs of the gypsy moth by smearing their stacks on the trees. Kerosene is also utilized in case of necessity to exterminate conglomerations of pests on weeds.

On the whole from kerosene are prepared kerosene-soap and kerosene-lime emulsions. Kerosene-soap emulsion is prepared from 0.15-0.75% of soap and 1-4% of kerosene. For late fall or early spring sprayings of trees more concentrated emulsions (8-10% of kerosene with a corresponding increase of soap) are used. They are used for spraying to control psylla and aphids. On hot days it burns the plants.

Kerosene-lime emulsion is used for moist disinfection of grain and fruit storage places (per 1 L. of water 100g of kerosene, 200g of lime are used for spraying; for coating - 100g of kerosene, 400g of lime per 1 L. of water).

For greasing the cracks a still thicker emulsion is used (100g of kerosene, 600g of lime per 1 L. of water). [Begin p.46].

It is highly effective for the extermination of Pediculoides ventricosus.

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Output of the emulsion is 1 L. for 1 m^2 of the treated area.

Fluosilicate of sodium. A thinly ground powder of white color with a creamy hue, or of a grayish color. It cakes in storage. It contains 93-95% of fluosilicate of sodium. It dissolves in water to about 1%. Almost does not burn the leaves and other parts of the plants. Neither sodium potash, chalk nor lime can be added to fluosilicate of sodium because with these the toxicity of the preparation is decreased and its burning properties increased.

Fluosilicate of sodium is a poison of intestinal action and is utilized only in its pure state. It is used for dusting, spraying and preparation of poisoned baits against harmful insects and mouse-like rodents.

Gives a high death rate when used for the control of caterpillars of cabbage butterfly, Phyllotreta cruciferae Goeze, diamond back moths, Agrotis segetum, cabbage cutworm moths, Phytometra gamma L., Meligethes aeneus F., and others.

The stirrers in the sprayer must operate during the work with the suspensions of the fluosilicate of sodium, else the poison settles to the bottom. The presence of molasses in the solution of the fluosilicate of sodium decreases the toxicity of the preparation.

If fluosilicate of sodium gets on the skin it can produce irritation, burns or even sores, especially on wounds. The moist parts of skin are affected the more often.

Creolin. It is a dark-brown or brown oily liquid with a sharp smell of tar. It is obtained during the dry distillation of coal or peat.

It is utilized in the form of 0.5-0.75% emulsion, or as a dust, which consists of 95 parts of ashes and of 5 parts of creolin. Dust (mixture) is prepared in seed treating machines of a type PSP-0.5 (formerly "1 deal") or in barrels.

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Emulsions are used for watering the plants for the control of cabbage maggot, to protect cabbage sprouts from rodents (50g per 1 L. of water), and for the control of onion maggots 1-2% of the water solution of creolin with a dose of 5-7 L. for 100 m of onion rows. Dust can be used instead of emulsion for the same pests.

It is also utilized for disinfection of hotbeds, hothouses and other buildings in a 2% concentration by means of spraying or coating.

When preparing a working emulsion, water is gradually added to creolin in small doses and the mixture is carefully stirred until a uniform liquid is obtained. A well prepared emulsion should not have any oily spots on the surface.

"Krysid" [a rat poison]. An organic synthetic substance. It is a brownish or gray fine crystalline powder, without any odor.

It is used for the extermination of mouselike rodents in the form of poisoned baits. Before the preparation of the bait krysid is ground and mixed with the bait in a proportion of 5-10g of poison per 1 kg of bait.

A lethal dose for the gray rat is 3-5 mg, for a house mouse - 0.5-1.0 mg per 1 kg of living weight. For small domestic animals it is less dangerous; for a rabbit the lethal dose is 400 mg, for chickens 450-500 mg per 1 kg of living weight.

Alkalies decompose krysid.

When working with it, it is necessary to observe established protective measures.

Potassium permanganate. Dark violet crystals with a weak metallic lustre, dissolves well in water, coloring it into dark violet or bright crimson color, depending on the concentration of the preparation dissolved in water. It is used for treatment of seeds of vegetable crops in the form of solutions of different concentration (from 0.1 to 10g for 1 L. of water).

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[Begin p.46].

The Institute of Vegetable Economy recommends a 1% solution of potassium permanganate for an additional treatment of tomato seeds to control streak diseases and mosaic. VIZR [All-Union Institute for the Protection of Plants] recommends this preparation for an additional disinfection of beet seeds.

During storage and handling of stocks of potassium permanganate it is necessary to observe precautions because its coming in contact with easily oxidising substances, for instance glycerine, can cause an explosion.

Copper sulfate. The pure preparation has a form of crystals of blue color. Sometimes it has admixtures of zinc sulfate, magnesium or green vitriol. It dissolves well in water, especially in hot water.

It is utilized for the extermination of pathogens of plant diseases. The preparation AB is made from copper sulfate.

It is used in the form of solutions only in combination with lime (Bordeaux mixture), for spraying the tops of potatoes for the control of Phytophtora infestans and early blight of potatoes, fruit trees and berry patches to control different diseases.

Of late, the 3-5% solutions of the Bordeaux mixture began to be utilized for spraying fruit trees in the fall or in spring before the opening of the buds. The 5% solution is also used to disinfect the roots of the planting material of fruit trees against Bacterium tumefaciens.

Mineral oils. A product of fractional distillation of petroleum. They are divided into 3 groups according to their physical properties. Light oils - solar, vaseline, transformer, pyronaphta (specific gravity 0.84-0.86); medium oil - spindle oil, and the heavy oils - machine and heavy cylinder oils. The last two kinds of oil have a specific gravity of 0.9 and higher.

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The oils have a contact insecticidal action and are used with great success for the control of mites, flea beetles, leaf-roller moths, scale insects and other pests, as well as for the eggs of pests, which overwinter on trees.

Oils with a lower viscosity are less dangerous for the plants. Oils with a high viscosity do not easily enter into the respiratory organs of the insects, and they can also burn the leaves.

According to the time of use the mineral oils are divided into "summer" and "winter". The summer oils, more refined and less viscous, are suitable for spraying the plants from spring to fall (transformer and solar oils). The winter oils have a greater viscosity, contain a high percentage of unsaturated hydrocarbons (sulfonating substances), and are utilized in autumn, after the fall of leaves and early in the spring, before the opening of buds (machine and the heavy cylinder oils).

Improper utilization of oils for spraying in summer causes the fall of leaves and fruits, and in winter lowers the flowering of plants.

Oils are used in the form of oily emulsions, into the composition of which enter the oil, the emulsifier (soap, or more often unctuous clay), and water. Mineral oil emulsions are used in various concentrations: 1-2% for the summer treatment oils, 4-8% for winter treatments. DDT, calcium arsenate and Paris green can be added to them. Such a combined emulsion is effective for the control of scale insects, curculionidae, leaf-roller moths, and other pests of fruit orchards, including San Jose scale. Spraying must be done early in the morning or after the 15-16th hour, otherwise there might be burns on the leaves.

Soaps are insecticides of contact action, but in effectiveness they are inferior to mineral oil emulsions, to anabasine-sulfate, and others. [Begin p.47

Both hard and soft soaps are used for the control of pests of agricultural plants; they are obtained by cooking fats with soda, sodium hydroxide,

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potash or potassium hydroxide. In the first case hard laundry soda soaps are obtained and in the second case potassium liquid, or green ones. The green soaps are more toxic to the insects.

The solution of soap spreads very well over the leaves, it moistens the body of the insect and, covering them with a film impermeable to gases, it hinders their respiration and exterminates the pests.

It is utilized for the control of insects with slightly sclerous coverings of the body or with mouth organs of the sucking type.

Soaps are used as emulsifiers in emulsions of kerosene, carbolic acid and mineral oils, as well as an addition to various solutions for their better adherence to the treated objects in a proportion of 3-4g per 1 L. of the basic solution.

A pure soap solution, which is utilized for the control of mites and psylla on fruit-berry plantings, on vegetable and other crops, must contain 3-4g of soap per 1 L. of water.

Naphthalene. It has a form of minute shiny, scaly crystals of white, pinkish or brown color with a pungent ordor. It does not dissolve in water. In a warm building, in a hotbed or hothouse it evaporates comparatively fast. It melts at 80°, boils at 218°.

It is utilized for the control of mites and other granary pests by means of dusting the seeds of rye, barley, oats, clover and vegetable crops. Doses depend on the crop. It can be utilized to repel cabbage maggots and carrot rust flies; for this prupose naphthalene is sprinkled over the soil near the plants.

It is also used, with sufficient effectiveness, for the control of Tetranychidae and of thrips in hothouses and hotbeds. For this purpose naphthalene is heated up to evaporation on lamps in a proportion of 10g per 1 m^3 of the area. At high temperatures it can burn the plants (especially

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cucumbers); at low temperatures it has little effectiveness.

In general it is widely used for the protection of fur and woolen articles from moths, as also for the protection of collections of insects, birds and animals.

Nicotine sulfate. A liquid of dark-brown color, dissolves well in water. Contains 40% of the nicotine-base. It is very poisonous to men and animals (0.05-0.15g of pure nicotine is a lethal dose). It can enter the blood through the skin.

It is a poison of contact action. It is utilized in the form of solutions (1.5-2g of poison per 1 L. of water with an addition of 4-5g of soap), or in the form of 5-,7-,8-, or 10% nicodust, which is prepared from road dirt or lime. The last one is prepared in the seed treating machine PSP-0.5 (former "Ideal") where small portions of material can be mixed, and must be used the same day of preparation as it loses its toxicity very rapidly.

It gives good results in the control of Hyponomeuta malinella Zell., of psylla, of Caliroa limacina Retz., of Tetranychidae (on cucumbers), of Phyllotreta vittula, Aphthona euphorbiae and Chaetocnema brevinscula Fald., diamond back moth, cabbage, apple and other aphids.

Spraying with nicotine sulfate solution or dusting with a nicodust the plots of Cruciferae, where the plants are left to run to seed, protects them from damage by the cabbage snout beetle.

NIUIF-1. It is a crystalline substance (ethylmercurophosphate) of white color. It dissolves well in water and alcohol, and poorly in hydrocarbons and oils. Very poisonous. The chemical industry puts out NIUIF-1 for the use in farming as a concentrated solution of carmine color; 1.5% in strength; it is utilized for [Begin p.48] moist treatment of seeds of various agricultural crops.

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The working solution is obtained by mixing 1 part of the 1.3% solution with 400 or 600 parts of water, depending on the crop or diseases of the plants. For treatments of cucumber seeds a much stronger working solution is used (one part of the 1.3% solution of NIUIF-1 for 300 parts of water). The working solution is prepared during the day of its utilization and only in a wooden or glass vessel. This preparation must be stored in a dark place in a dark glass utensil.

NIUIF-1 is highly effective for the extermination of pathogens of Fusarium and of Helminthosporium on wheat and barley. The autumn treatment of cabbage seeds, which is highly infected by leaf spot (Alternaria), also gives good results. The seeds, which were moistened with the solution are "steamed" for 15-30 minutes, after which they are planted. The seeds can be treated 3-4 weeks before planting. The output of the working solution per 1 c of grain seeds is 10-15 L.

2 or 3 batches of seeds can be treated in the same solution.

For a protracted storage, the seed treated with this preparation must be dried to 14-15% of moisture content.

NIUIF-2 (granosan). Mercuric-organic preparation; it consists of 2-2.5% of ethyl-mercury-chloride, 97.4-96.3% of talcum and 0.6-1.2% of mineral oil.

This is a powdery preparation of a light gray color, it does not burn; it does not dissolve in acids. It is utilized for a dry treatment of seeds of various agricultural crops, both of the naked grains (rye, wheat, clover, and others), and of the scaly (oats, barley, timothy), which permits the replacement of the laborious and inconvenient treatment with formalin.

It is a general-purpose treating substance for a complex of pathogens of diseases of flax, grains, vegetables, fodder root crops and of clover such as: smut, Fusarium, Helminthosporium, Alternaria, and others.

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The seeds can be treated with the preparation NIUIF-2 immediately before planting or beforehand at anytime, but not more than 2-3 months before planting (with the exception of cabbage seeds). The cabbage seeds which are strongly infected by Alternaria can be treated right after harvesting, threshing and drying.

The preparation stimulates the germinating energy, the sprouting of seeds and the growth of plants; this increases the yield of the crop to a considerable degree.

Doses of the preparation for treating the seeds are determined depending on the crop. For 1 c of wheat and rye seeds - 100g of the preparation, for seeds of barley and clover - 150g, for oats - 200g; for vegetable crops 3 to 5g of the preparation for 1 kg of seeds.

Treatment (mixing of seeds with the poison) is conducted in treating machines PU-1 or PSP-0.5.

The seeds, treated by this preparation, are poisonous.

NIUIF-100 (thiophos). It is a dark brown, heavy, oily liquid with a characteristic smell. The preparation dissolves in water only insignificantly. The full name of the preparation is diethylparanitrophenylthiophosphate.

The chemical industry puts out the preparation NIUIF-100 in the form of a 40-50% liquid concentrate and of a 1-2% dust.

The working solution is prepared from these concentrates. Usually 0.5g of the concentrate are taken to 1 L. of water. It has also been tested for the control of Tetranychidae in a form of suspension (15g of 1% preparation and 4g of unctuous clay per 1 L. of water).

It is poisonous to men and animals. It is utilized for spraying technical crops, which are not used as food for men and fodder for cattle; it is utilized for spraying fruit, berry and melon patch crops only before the

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fruits set; on other crops spraying is discontinued 30 days before harvesting the yield. Scallions and lettuce should never be treated [Begin p.49] with thiophos. It can be utilized for disinfection of hotbeds and hothouses by spraying.

Paradichlorobenzene. It is a product of the coal-tar chemical industry. The crystals are of white or brownish color. It does not dissolve in water, but dissolves well in kerosene, benzene, carbon bisulfide. It evaporates slowly, generating noninflammable vapors which are 5.1 times heavier than air. With an increased moisture content and a lower temperature evaporation decreases.

It is utilized as a fumigant for the control of many pests which inhabit the soil: larvae of the May beetle, of Amphimallon solstitiale L., and others by means of introducing it into the holes 5-10 cm deep at a distance of 50 cm one from the other with a dose of 7-10g into each hole.

Can be utilized in a mixture with carbon bisulfide (1:1), at a rate of 15g of the mixture per 1 m^2 of the area. In fruit tree nurseries paradichlorobenzene is introduced into shallow furrows near the plants at a rate of 25-30g of poison for 1 m of the row.

The preparation can produce a harmful action on the roots of plants, thus it should not be introduced nearer than 6-10 cm from the bush or the trunk of the tree. It is especially dangerous to introduce large doses under young trees.

It is also utilized for the control of the caterpillars of leopard moths by means of packing into the bores made by the caterpillars pieces of cotton saturated with a solution of paradichlorobenzene.

Paris green. Thin powder of a bright green color. It does not dissolve in water, but forms a suspension which settles to the bottom very quickly; one

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should keep in mind this circumstance when utilizing this poison; when spraying, it is necessary to shake the knapsack apparatus or use sprayers with stirrers. It dissolves in a water solution of ammonia. It contains not less than 51.5-53% of arsenic trioxide, up to 3% of which is dissolvable, from 28 to 30.5% of cupric oxide, and not more than 1.2% of moisture.

It has an intestinal action, and thus is utilized for the extermination of insects with sucking mouth organs (caterpillars of cabbage and turnip butterflies, diamond back moths, cabbage cutworm moths, of caterpillars of Hyponomenta malinella Zell., and of the leaf roller moths, of brown-tail moths, Malacosoma neustria L., and many others.

Is utilized for the spraying of fruit-berry plantings, of vegetable, grain, legume, fodder root crops and other crops, of cruciferae plants which are left to run to seeds, of decorative buches and trees, of field shelterbelts. It is also used for the preparation of poisoned bait made of cut grass for the control of Agrotis segetum.

Can be also utilized for dusting in a mixture with lime, ash, or other diluent, but this method of use is uneconomical, because thus more poison is expanded, than it is with spraying.

When preparing the solution the preparation is mixed with a double amount of quick or freshly slaked lime, in order to neutralize in the solution the acid salts which develop and the free arsenical acid, which are the cause of plant burns.

The solution is prepared in a clay or wooden vessel. At first the Paris green is slightly moistened and carefully rubbed with a paddle. In another vessel a lime solution is prepared - the lime milk. Then the solutions are poured through a strainer into one utensil and are shaken well.

Besides the Paris green, the industry puts out "Shchelkovskaia" green; it has a form of bright green powder, it contains not less than 32% of arsenic

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trioxide and 17.6% of cupric oxide. It is utilized for the control of the same pests as the Paris green, but in increased doses of 15-20%.

Pyrethrum. Finely ground powder, having the color of tobacco. It is prepared by means of grinding the Dalmatian and Caucasian camomile, and of the pellitory of Spain. [Begin p.60].

The poisonous base of pyrethrum is pyrethrin I and pyrethrin II, of which an amount of up to 1.64% is contained in the flowers and stalks of the plants. The flowers contain 5-10 times more pyrethrin than the stalks.

The preparation is best stored in the form of extracts, because in powder form it loses up to 45% of its active ingredient during the course of a year.

It affects the insects mainly as a contact poison which produces paralysis. It is tutilized for fumigating hothouses (in a proportion of 2-4g per 1 m^3), for dusting the plants with dust, which is prepared with a benzene extract of pyrethrum. It exterminates well the Phyllotreta cruciferae Goeze, the caterpillars of cabbage butterflies, and other harmful insects. It does not produce any burns on plants.

It is utilized in the orchard, in granaries and on vegetable crops, whose leaves are used in food, such as sorrel, lettuce, cabbage. It has but little toxicity against aphids.

Pyrethrum should not be mixed with sulfur or lime, as it loses its toxicity then.

It is harmless to men and to warm blooded animals.

Preparation of Prof. B. I. Zbarskii. A mercurio-organic preparation, which is a powder of white color. It is utilized for treating the seeds of cabbage, tomatoes and cucumbers.

A solution is prepared for treating the seeds. 1.2g of powder are dissolved in 1 L. of hot water; into this liquid are added 2g of purified

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sodium and it is boiled until the full dissolving of the powder and soda (about 15 minutes), after which the solution should be cooled. From the thus obtained solution (1.2:1000) a working solution is prepared for the disinfection of seeds by means of mixing 1 part of the solution with 4 parts of water. The obtained liquid (1.2:5000) is then utilized for the treatment of seeds.

The seeds are kept in this solution up to 30 minutes. Two-three batches of seeds can be disinfected in the same solution.

The preparation is not poisonous to men and animals.

Preparation no. 47. It is a liquid of a brown or black color, with an unpleasant odor. It dissolves very little in water; it dissolves well in alcohol, dichloroethane, and in other organic solvents. It is poisonous to men and animals; it is very irritating to the mucous membrane of the skin. When it gets on the skin it produces a sensation of burning, which passes very fast. It burns the plants in its pure state.

For the extermination of pests it is utilized in the form of clayey emulsions, of solutions in special solvents, as 5-10% dusts made with talcum and kaolin.

It is effective for the control of aphids at a concentration of 0.3% in the form of tank mixture with water.

A concentrated emulsion is also prepared for spraying, which looks like a thick liquid of a gray color and contains 60% of the active ingredient of the preparation.

Protras. This a preparation of a gray or yellowish color, which consists of calcium arsenite and of talcum. The standard preparation consists of 9-11% of arsenic trioxide and not more than 1% of moisture. It is very poisonous to man and animals.

It is utilized for the disinfection of seeds of wheat, rye, flax,

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clover and of naked seeded varieties of barley and oats by a method of dry treatment in the machines PU-1 or PSP-0.5. The norms for the expenditures of the preparation depend on the crop: for 1 c of seeds of the grain crops 100g of protras are used, for clover - 200g, for flax - 150g. One should not use protras for treatment of wheat seeds, which were already treated with naphtalene against Tetranychidae, nor for the seeds which are vernalized. Seeds, which were treated with azotobacterin are treated with protras immediately before planting. [Begin p.51]

Protras is not being used for disinfecting vegetable seeds.

Treatment of flax seeds is conducted anytime before planting, but not more than 5 days, of clover 45 days and of grains 30 days before planting. The disinfected seeds are poisonous, and should not be fed to cattle or poultry.

Sulfur. Sulfur is used in the form of lumps, as a powder (lumps of sulfur which were ground in ball mills), of flowers of sulfur (which are obtained during sublimation of sulfur), and of sulfuric concentrate (finely ground native sulfur together with the ordinary rock with a content of 20-80% of sulfur).

Sulfur powders are utilized for dusting the grape vines for the control of oidium, for melon patch crops for the control of Erysiphe graminis and of anthrachose, for alfalfa, roses, hops and other crops for the control of Erysiphe graminis (15-20 kg/ha). For the sake of economy as well as for better adherence it is recommended to mix sulfur with lime, road dust, and the like (1 part of sulfuric powder to 1 part of the filler).

The ground sulfur is also used for the control of Tetranychidae in hotbeds and hothouses by means of dusting or evaporation.

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Fumigation of hermetically closed buildings is done by burning dry sulfur at a rate of 60-150g per 1 m^3.

The lump and the ground sulfur is utilized for the preparation of the lime-sulfur decoction, ISO.

Sulfur burns some plants, and during burning it damages metallic articles.

Of late into the practice for the protection of plants a new effective preparation of "colloidal sulfur" (or paste of gaseous sulfur) was introduced; it is a waste of the gas industry. The preparation is a highly dispersed sulfur, which contains a sulfide lye as the stabilizer. It is utilized in the form of colloidal solutions as a substitute for sulfur preparations with a concentration of 1.5-2% for ground spraying (output up to 800 l/ha, and for the airplane method of spraying a concentration of 10-12% at a norm of output of 50 l/ha.

Sulfur dioxide. A colorless gas with a strong smell. Its specific gravity in respect to the air is 2.26.

Sulfur dioxide is easily condensed into a liquid and stored in stell cylinders. In practice the gas is obtained by burning sulfur.

Sulfur dioxide is mainly utilized for gassing empty premises, hothouses, hotbeds, and the like in order to exterminate dangerous insects, mites, mouselike rodents and pathogens of disease.

In vegetable storage houses the dose of sulfur dioxide in liquefied form is 24g per 1 m^3. If gassing is done by burning sulfur then its dose is from 50 to 150g per 1 m^3 of the compartment. Exposure is for 24-36 hours, the airing after the gassing should be for 24-48 hours, and of hotbeds and hothouses up to 10 days.

One should conduct the gassing of the premises at a temperature of 10-16°. Gassing at low temperatures or in humid premises is little effective or not effective at all.

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The sulfurous acid which develops in water during the dissolving of gas damages the plants, decreases the germination ability of seeds, discolors the dyes and can influence the durability of fabrics.

Carbon bisulfide. It is a liquid of a yellowish tint with a pungent disagreeable odor, reminiscent of the smell of rotten eggs. The technical product contains about 95% of carbon bisulfide.

Carbon bisulfide vapors are 2.65 times heavier than air. It dissolves in water very little. It mixes well with kerosene, chloropicrin, dichloroethane, alcohol and other organic solvents. It yellows in the light. [Begin p. 52]

It inflames from any spark, blow, and even from a strong friction of two articles against each other. It is spontaneously inflammable, at a temperature of 150-300°. It forms inflammable and explosive mixtures with the air (in a concentration of 32g/m^3 and over). For the prevention of explosions it is mixed with carbon tetrachloride in a proportion of 1:4 (chloride mixture).

It is utilized as a fumigant for the disinsection of soil, of seeds, packing sacks, as well as of closed premises for the control of mites, their eggs, and of other storage pests at a rate of 220-375g per 1 m^3 of the premises, depending on the kind of product. Exposure is for 36 to 72 hours.

The seeds of clover and peas, the flower bulbs, the Siberian marmot holes are gassed. The germination of seeds is not decreased by the vapors of carbon bisulfide. At the present time it is used mainly as a chloride mixture.

Mercuric chloride. A white, or grayish heavy crystalline powder with a pink tinge. An insectofungicide. It belongs to strongly active poisons.

It is utilized for disinfecting the seeds against fungi and bacterial diseases. It is utilized in a form of aqueous solutions of different concentrations, depending on the purpose, pest or the pathogen of disease.

For tomato seeds a concentration of the solution 1:3000 is used (soak-

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ing for 5 minutes), for cucumbers and cabbage - 1:1000 (steeping for 10 minutes); for carrots - 1:1000 (soaking for 10-30 minutes).

The seeds thus treated are washed in water for 10 minutes, changing the water 5-10 times, after which they are dried. The output of the mercuric chloride is 1g per 1 kg of seeds.

The saplings of fruit crops are disinfected in a 0.1% solution for the control of Bacterium tumefaciens, with an exposure of 2-3 minutes and a following immediate washing of saplings in clean water.

One is not allowed to pour out the solutions of mercuric chloride in the vicinity of wells, into the river or other water reservoirs.

Formalin. It is a colorless liquid. It does not burn. It mixes well with water. Formalin vapors irritate the mucous membrane of the eyes and of the respiratory organs. The standard formalin is a 40% water solution of formaldehyde.

The percentage content of the active ingredient (of formaldehyde) in the formalin is determined according to specific gravity by a hydrometer for liquids heavier than water.

During storage in a cold place a white or a yellowish sediment forms in formalin, which is dissolved at the heating of formalin or on mixing the formalin solution with a sodium solution (washing soda 8g or caustic soda 4g per 1 L. of water) in equal parts (1:1).

The 40% formalin, which was mixed in equal parts with soda solution, is 20% strong, which must be taken into consideration when preparing the working solutions.

It is a fungicide and is utilized for the extermination of pathogens of diseases of plants.

It is utilized for a wet and moist treatment of seeds, for disinfection of soil, mainly in hotbeds and hothouses, for the disinfection of hothouses,

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hotbeds, of fruit and vegetable storage houses, of packing sacks, of tarpaulins, agricultural machinery and other agricultural implements.

Formaldehyde vapors are the active ingredient of formalin, that is why the seeds, which were moistened with the formalin solution, during treatment are covered by a tarpaulin and left to "stew" for 2-4 hours. When disinfecting premises, hotbeds, hothouses, machinery and agricultural implements they are exposed for from 24 to 48 hours. For a wet treatment 1 part of the 40% formalin is dissolved with 300 parts of water; for a moist - 1 part formalin is dissolved with 80 parts of water. [Begin p.63].

The seeds of wheat, of rye and the naked seeded varieties of barley and oats should not be treated by the moist method.

Zinc phosphide. A dark gray heavy powder with a lustre and a smell of hydrogen phosphide. It does not burn. It does not dissolve in water. Contains from 15 to 24% of phosphorus. Its specific gravity is 4.76. It is a highly effective substance for the control of mouselike rodents: 3-5 mg of this poison is a lethal dose for a gray rat.

It is utilized in various baits at the rate of 2-5% to the weight of the product; to grain baits it is attached with a sizing, a vegetable oil, or the like. Dusting with it, the sprouts in hotbeds and the seedlings of tree crops protects them from rodents.

Zinc phosphide should not be utilized together with a sour bread, because under the influence of acids the preparation decomposes with a liberation of hydrogen phosphide.

Zinc phosphide's disadvantage is its unpleasant smell of hydrogen phosphide (the smell of garlic).

When utilizing it one must observe the same precautionary measures, as during the work with the yellow phosphorus.

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It is poisonous to men and animals.

Sodium fluoride. Dingy white or somewhat gray powder, often caking into lumps. The standard preparation contains 82-83% of sodium fluoride. It dissolves in water. No lime or chalk should be added to the solution of this poison as this will lower its toxicity.

It is used only by the method of spraying in the form of 0.5-1% solution for the control of beet curculionidae, of the leaf beetle, flea beetle, beet webworm, of locustidae and many other pests of vegetable crops. For the control of caterpillars on vegetable crops a 0.5-0.8% solution is used. The freshly prepared solutions are especially effective. For a better adherence to the leaves molasses or flour paste are added in an amount of about 10g per 1 L. of solution. Spraying of fruit-berry plantings is conducted during the second half of the vegetative period when the leaves become hardened, as the solution of the preparation burns the young leaves.

In the absence of arsenic and of the fluosilicate of sodium, sodium fluoride can be utilized for the preparation of poisoned baits with oil cakes, flour, cut grass, and the like (for 100 kg of bait take 2-3.5 kg of poison).

It is poisonous to men and animals.

Chloropicrin. A heavy, greasy transparent liquid of a somewhat yellowish color. The technical preparation contains 95% of pure chloropicrin. It is widely used for gassing the soil, of empty, hermetically closed, premises, elevators, railroad cars, packing materials, and ships for the control of poisonous insects, mites, and for poisoning the mouselike rodents.

Chloropicrin vapors are 5.67 times heavier than air. It dissolves well in ethyl alcohol, in kerosene or ethyl ether. It dissolves in water 1.65g per 1 L. of water at a temperature of 18°. From a 1 m^2 of surface it evaporates at 2.5g per minute at 20°, and 5.5g at 30°. For speeding the

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evaporation during gassing of premises, sacks are moistened with chloropicrin and suspended on the premises.

At great concentrations it produces a strong irritation of the mucous membrane of the eyes, hampers breathing. A concentration of 1g per 1 m^3 of air is considered to be lethal.

During the application of chloropicrin it is necessary to utilize gas masks.

When gassing premises, the dosage of chloropicrin is accepted as 20-35g for 1 m^3 with an exposure for 3 days. Disinfection with chloropicrin can be applied only to that grain which is used for grinding. It is prohibited to disinfect the grains which are intended for planting. [Begin p.64].

Barium chloride. It is a crystalline substance, which looks like table salt. It dissolves in water easily. It contains 94-96% of barium chloride; not more than 4% of hygroscopic moisture. The preparation is divided into varieties A and B. The variety A is utilized for the control of pests; it has a form of yellow-brown fine crystals, which are somewhat soiled with various admixtures. Variety B is the chemically pure preparation. The disadvantage of barium chloride is that it is easily washed off the leaves by rain and even by dew. It is utilized during dry weather.

It is utilized as a poison of internal action for the control of beet curculionidae, caterpillars of the beet webworm, leaf roller, of Phytometra gamma L., larvae of leaf beetles, of Athalia colibri Christ., of various Sitona, and other pests.

3-4% aqueous solutions are utilized for spraying. During airplane treatments a 20% concentration solution is utilized with a norm of output of 50 l/ha. For a better adherence to the leaves 10g of molasses or of flour paste are added to each 1 L. of solution.

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The chemical industry is putting out barium chloride in plywood drums or wooden barrels. It is poisonous to men and animals.

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Trans. A-816
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Zhuravskii, G. I.

Glubinnyi sposob proizvodstva limonnoi kisloty pri pomoshchy griba Aspergillus niger.

[Submerged method of citric acid production with the aid of the fungus Aspergillus niger].

Mikrobiologiia, vol. 24, no. 3, p.332-340. May/June 1955. 448.3 M582

(In Russian)

Owing to its taste qualities and its physico-chemical properties, citric acid has a wide application in the national economy, and especially in food industry.

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In nature we find it in fruits and leaves of various plants (lemons, oranges, cranberries [Oxycoccus palustris], black currants, in the leaves of tobacco [Nicotiana rustica], string beans and in other objects).

Since long ago citric acid was obtained mainly from lemons, the juice of which contains it from 2 to 6% [1]. But the ever growing demand for citric acid and the limitations for obtaining it from objects in the plant world led, at the end of last century, to a necessity to find other sources of citric acid.

Development of technical microbiology opened unlimited possibilities for the utilization of biochemical properties of microorganisms in industrial processes. Among them was utilized the ability of some mold fungi, related to the genus Aspergillus, to synthesize citric acid on sacchariferous substrate. In the Soviet Union microbiological production of citric acid came into being at the beginning of the thirties thanks to the work of V. S. Butkevich, S. P. Kostychev and of their students.

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For the production of citric acid usually those varieties of the fungus Aspergillus niger are selected which are the most active in acid formation. The specially compounded sacchariferous nutritive medium is seeded with conidia of the fungus-acidifier and is poured in a 2-8 cm layer into large, flat vessels, which are piled up in stacks in a closed compartment - a fermentation chamber. The mycelia which grow on the surface of the solution, covering it with a continuous coating, synthesize citric acid at the expense of carbohydrate which they absorb from the solution; and the acid which accumulates in the cells of the mycelia is secreted into the fermenting solution.

The process of acid-formation with the aid of such a film floating on the surface can proceed very intensively. A mycelial film covering 1 m^2 area, secretes under production conditions over 600g, and in certain cases even 800g of citric acid per 24 hours. The acid fermented solutiom are poured together and undergo a comparatively simple chemical treatment for the separation from them of crystalline citric acid [5].

When producing citric acid by a microbiological method, the physiological process of accumulation of organic acids by the living cells proved to be more effective, and economically more profitable, than the process of production of acid from lemons. On the one hand, such a carbohydrate rich crop as sugar beets is utilized at its maximum, on the other hand the high physiological ability of the cells of the mold fungus is utilized for converting these carbohydrates into the citric acid.

Notwithstanding the achieved successes, the production of citric acid with the aid of the film of the fungus-acidifier, floating on the surface, [Begin p.385] has several serious drawbacks. The surface method requires large production areas, and a great number of flat vessels, where the process of

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acid formation is accomplished. The character of the technological equipment in the fermenting shop hampers the mechanization of the labor-consuming works and the automatization of the technological process. This method practically does not guarantee any sterile conditions for the process and for this reason, notwithstanding the efforts of the production workers, it periodically suffers from extraneous microflora, which at times lowers very sharply the synthetic activity of the fungus. These defects, as well as several others, naturally retard a further development of the production of citric acid by the surface method.

It was a long time ago that thoughts of researchers were directed towards development of a more promising - the submerged method of production of citric acid [7].

Unlike the natural surface method of cultivation of fungus, during the submerged method the mycelium expands not on the surface of the solution, but through its whole mass. During the surface method the body of the fungus is not under similar conditions of nutrition and aeration, and that is why all of its cells cannot synthesize equally well the citric acid.

Thus, a submerged method already in principle opens wide possibilities for a considerable increase of production at the expense of a fuller utilization of the acid-forming ability of the submerged mycelium, as well as by utilizing simultaneously greater volumes of fermenting solutions, which takes place when many flat vessels are replaced by large volume fermentors.

Yet the accomplishment of citric acid production by the submerged method represents a complicated problem both in the biological, as well as in technical respect. The difficulty of solving it consists not only in the fact that the aerobic fungus organism must be adapted to the existence under submerged conditions which are unusual for it, but also in directing

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its active life preeminently into the production of citric acid. Under these conditions of cultivation a mycelium of a special structure is formed, whereupon the changes in conditions of aeration and nutrition, as well as the interference of new factors, which are often unstable and very difficult to discern, considerably influence the process and hamper very much the solution of the given problem. It was not by accident then that the earlier attempts to realize the production of citric acid by the submerged methods had no success [9].

At the present time the problem of obtaining citric acid by the submerged method has found its positive solution in the works which were conducted by the laboratory of the All-Union Scientific-Research Institute of Confectionery Industry in cooperation with the Leningrad Factory of Citric Acid under the leadership of the author of this article.

Following the basic statutes of Soviet biological science the group began the research of the problem by looking for and studying the physiological mechanism of the metabolic activity of the fungus-acid former depending on the changing conditions of the environment.

The new specific conditions for the submerged method of conducting the process demanded:

1) development of new methods of research and preparing special apparatus, which will answer the physiological requirements of the submerged culture of the fungus-acid former; [Begin p.334]

2) selection of strains of fungi, which will be the most active in the formation of citric acid under conditions of a submerged cultivation;

3) work out conditions for nutrition, aeration, temperature regime and other conditions, which will permit not only to find out, but also to increase the ability of selected strains for an active synthesis of citric acid during their submerged cultivation.

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Stirrers of a rotary type, such as are employed in laboratories, as well as stirrers of an alternate motion type, were utilized with great success at the beginning of research for the conducting of experiments. Later on the researches were conducted under more perfect conditions from the point of view of aeration of the submerged culture, in apparatus with mechanical stirrers set up in 20-liter glass carboys (figure 1).

Title of figure 1. Apparatus for cultivation of the submerged mycelia of the fungus Asp. Niger.
1- a cork with a packing gland and a rubber gasket; 2- mechanical stirrer; 3- entrance for sterilized air; 4- outlet for air; 5- thermometer.

Aeration of the submerged culture was achieved by means of blowing through sterilized, dispersed air through the fermenting solution, with a culture of fungi submerged in it, and with a synchronous stirring of the whole mass with the aid of mechanical stirrers or by means of shaking the experimental vessels.

One of the decisive conditions for a successful realization of the submerged method of citric acid production is the selection of a biochemically active strain of the fungus-acidifier under such conditions; its high activity in the synthesis of citric acid can be found out by means of creating for this organism the needed conditions of environment: nutrition, aeration and others.

As a result of comparative tests of active strains and of developing conditions for cultivation, needed by them, several strains were selected, which were suitable for the conducting of the process under submerged conditions: Aspergillus Wentii, strain G; Aspergillus niger, strain no. 82 (D) and no. 90. Strain no. 82 (D), which showed the greatest activity in acid formation under submerged conditions, was accepted for laboratory research, and later on was turned over to production. It is interesting to note that this strain during the surface method of cultivation was inferior in its

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acid formation activity to the best producing strain no. 6/5 from the Leningrad Factory of Citric Acid. But under submerged conditions as it is seen from table 1 the strain no. 82 (D) proved to be considerably more active, than strain no. 6/5.

From this instance it is visually seen how two closely related organisms, belonging to one species, demand different conditions for the realization of their ability for synthesizing citric acid on the ground of their specific natural peculiarities.

Constant morphological and biochemical observations of the state of the production strain no. 82 (D) have shown, that this strain as well as many other strains of the genus Aspergillus have a stepped up tendency for the formation of new forms. During seedings on an agar medium one observes, among the homogenous dark colonies of the initial strain, the appearance of morphologically different colonies of the arisen new variants (figure 2). New forms, isolated in pure culture, are shown [Begin p.335] in figure 3. Form no. 2 differs sharply from the initial strain in the morphology of colonies, while form no. 9 also by a poor ability for synthesizing citric acid.

From the initial strain 82 (D) over 30 variants were isolated during a comparatively short period of time, most of which possessed a lowered activity for acid formation.

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Table 1.

Comparative testing of acid forming activity of strains of the fungus *Aspergillus niger*. (Duration of the experiment - 10 days)

Fungal strains	Surface method		Submerged method	
	Citric acid obtained per vessel in g	ratio in %	Citric acid obtained per vessel in g	ratio in %
no. 6/5	87.1	100.0	49.5	100.0
no. 82 (D)	51.3	58.9	90.2	182.2

This circumstance led to the necessity for the formation of new technology for the preparation of the seeding material; for its basis there was prescribed a timely renewal of aging transplantings and separation of the strains from newly evolved inactive forms; also a limitation of the number of consecutive passagings of the isolated culture during the industrial propagation of conidia.

For obtaining the seeding material (fungus conidia), spore-bearing fungal mats are cultivated by the surface method on nutritive media specially prepared by us [5,6].

It was determined that the best density for the seeding during the submerged method of conducting the process consists of 600-700 thousand conidia in 1 ml of the fermenting medium.

Further tests have shown that seeding of the medium with conidia which were preliminarily germinated for 12-24 hours, speeds up the industrial process of citric acid production by the submerged method approximately by 10%, and lowers, the output of seeding material at least two times.

A specific cultivation of the acid-forming submerged mycelia necessitated studies of the natural requirements of the fungi to conditions of nutrition.

In our laboratory yet in 1948, as a result of numerous investigations, a special nutritive medium BB2 was develpped; it contained in one L: urea -

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1.0g; NH_4Cl - 0.8g; $MgSO_4 \cdot 7H_2O$ - 0.5g; KH_2PO_4 - 0.16g; KCl -- 0.07g; $MnSO_4 \cdot 7H_2O$ - 0.02g; $ZnSO_4 \cdot 7H_2O$ - 0.01g and 150.0g of beet sugar. This medium not only provided for the growth and formation of the most active acid forming mycelia under submerged conditions, but also permitted us to direct the process toward synthesis mainly of citric acid [2].

This then showed, in spite of the existing contradictory opinions, the unconditional feasibility of obtaining citric acid by the submerged method of fermentation.

Under laboratory conditions, in vessels, which were equipped with mechanical stirrers and contained 10 L. of the medium BB_2, during a 10-day cycle of continuous cultivation there were obtained 75-90g of citric acid from each liter of the initial nutritive solution. Semi-production tests have confirmed these results. When fermenting in [Begin p.336] a fermentor with 250 L. of the medium, during a ten-day period 80-85 kg of citric acid were synthesized, per 1 m^3 of the initial solution.

Nitrogen and phosphorus of the nutritive medium are of especially important significance for the formation of mycelia which are highly active in the synthesis of citric acid.

As the investigations have shown, a combination of the organic nitrogen of urea with the mineral creates favorable conditions for the nitrogen nutrition of the submerged culture. The optimal dose of phosphorus is at a content of 0.16g of KH_2PO_4 in 1 L. of medium.

Our further investigations have shown a certain increase in acid formation in that case when mineral nitrogen is introduced into the medium in the form of NH_4NO_3 [4]. Thus, along with BB_2 medium there appeared another, close to it, medium BO_2.

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The processes of respiration and of synthesis of citric acid in acid-forming fungi, is of course, fully linked to the conditions of aeration. The very entrance of the food elements into the cells of the organism, which is a complicated physiological act, is in close interconnection with oxidizing energy conversions occurring in the cells and thus must also be determined by the conditions of aeration of the mycelia. This circumstance acquires an especially important meaning during cultivation of the fungus under submerged conditions, which are unnatural for it.

Table 2.

Acid formation of a submerged culture of the fungus Aspergillus niger, strain no. 82 (D) in various nutritive media under conditions of insufficient aeration (an experiment on a rocking device).

Indicators	Nutritive medium		
	of Waksman-Karow	BB_2	A_4
Yield of citric acid in g/l	21.5	37.0	11.2
Ratio in %	58.2	100.0	30.3

Actually, by improving the conditions of aeration of the submerged culture, by increasing the amount of the air passing through it, combining the blowing with an energetic mixing and thus increasing the amount of oxygen dissolved in the fermented mass, we could uncover sharp changes in the relation of the acid-forming organism to the nutritive medium. Under these conditions of more complete aeration, we have developed and used, together with the mediums BB_2 and BO_2 medium A_4, which is still more effective for the synthesis of citric acid and is much simpler in its composition.

This medium has no urea and is composed of only three salts: NH_4NO_3 - 2.5g; $MgSO_4 \cdot 7H_2O$ - 0.25g and KH_2PO_4 - 0.16g in 1 L. of 15% sugar solution. During the experiments on a rocking device, under conditions of

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comparatively insufficient aeration, medium A_4 provides for very poor acid formation by the fungus, as it is seen from table 2, and in this respect is considerably inferior not only to the BB_2 medium, but also to the Waksman-Karow medium [6], which was recommended by the authors especially for submerged fermentation and contains in 1 L. of 15% sugar solution: urea - 1.0g; KH_2PO_4 - 0.08g; $MgSO_4 \cdot 7H_2O$ - 0.5g; KCl - 0.15g; $MnSO_4 \cdot 7H_2O$ - 0.02g and $ZnSO_4 \cdot 7H_2O$ - 0.01g.

But under conditions of a more perfect aeration, as can be seen from table 3, together with an increase in production of citric acid by the fungus,

(sentence is continued on page 337, after table 3)

Title of figure 2. Variability of strain no. 82 (D) of fungus *Asp. niger*. Among the dark colonies of the alternate reseeding of the strain, are seen light colonies of the freshly emerged form.

Title of figure 3. The isolated forms of the variant no. 2 (at left) and no. 9 (at right). Words in the left figure: strain no. 82, form 2 (active).
in the right figure: strain no. 82, form 9 (slightly active).

Title of figure 5. Microphotograph of eight day old, mycelia, grown under conditions of insufficient aeration of the submerged culture.

Title of figure 6. Microphotograph of eight day old;mycelia, grown under conditions of uninterrupted stirring of the submerged culture.

[Begin p.337].

Table 3.

Acid formation of submerged cultures of the fungus *Aspergillus niger*, strain no. 82 (D), on different nutritive mediums under conditions of a more thorough aeration (from an experiment in vessels with stirrers).

Indicators	Nutritive medium					
	BB_2	A_1	A_2	A_3	A_4	A_6
Contents of KH_2PO_4 in g/l	0.16	1.00	0.50	0.25	0.16	0.08
Yield of citric acid in g/l	62.74	64.69	71.79	72.81	82.11	76.32
Ratio in %	100.00	103.11	114.43	116.06	130.88	121.65

Footnote. Together with the BB_2 medium are shown variants of medium A (A_1, A_2, A_3, A_4, A_6), containing in a 15% solution of sugar: NH_4NO_3 - 2.5g; $MgSO_4 \cdot 7H_2O$ - 0.25g and KH_2PO_4 - varying amounts of grams.

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(continued from p.336) which was grown on medium BB_2, we note a sharper increase of citric acid synthesis by the fungus when it is cultivated on medium A_4. This sort of research shows very convincingly, that during insufficient aeration of the submerged culture the presence of urea nitrogen is indispensable in the nutritive medium for the realization of synthesis of citric acid. But this requirement by the organism for organic nitrogen is eliminated with a change to a more thorough aeration of the submerged mycelium.

From the last table we see that even under conditions of thorough aeration the dose of KH_2PO_4 in the new medium remains the same as in the medium BB_2, that is 0.16 g/l (medium A_4).

Title of figure 4. Dynamics of synthesis of citric acid by submerged mycelia of the fungus Asp. niger (strain no. 82 on the A_4 medium) 1- curve of the synthesis of citric acid; 2- curve of the growth of mycelia. Words to the left: citric acid in 100 ml of solution per g. Words to the right: dry mycelia in 100 ml of solution per g. Words at the bottom: time shown in 24-hour days.

Medium A_4, as one of the best variants which were developed by our laboratory, after careful checking was passed on to the shop for production of citric acid by a submerged method. By conversion, from each 1 m^3 of the initial solution, 90.69 kg of citric acid, were obtained on this medium in the fermentor. On the average, 11.8 kg of the acid was obtained from 1 m^3 of solution during a 24-hour day of the process. Yield of citric acid from the given sugar is 68.4%. A curve of the acid formation by the strain no. 82 (D) on medium A_4 is shown in figure 4.

From the above cited, it is seen that the conditions of aeration have a deciding importance for the processes of growth and of acid formation by the submerged culture of the fungus. One should take into consideration, that the aeration of the submerged culture depends on several interdependent moments: partial pressure of oxygen, which is supplied with the air, speed

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of aeration, degree of atomization of the air and the intensity of stirring of the submerged culture. The amount of oxygen, diluted in the nutritive medium has a special meaning. An insufficient aeration, which arises during a decrease of the air supply or a lowering of the intensity of stirring of the [Begin p.388] fermented mass produces a suppressed pathological growth of the submerged mycelia with the characteristic bulges of hyphae (figure 5 and 6) and a sharp decrease in the synthesis of the acid. From table 4 it is seen how the rising of intensity of stirring of the submerged culture, by means of an increase in the number of revolutions of the stirrer, heightens acid formation, which reaches its highests volume at 350 revolutions per minute.

Table 4.

Acid formation by the strain no. 82 (D) depending on conditions of stirring the submerged culture (an experiment in vessels with stirrers).

Number of revolutions of the stirrer per minute	Yield of citric acid for 10 days of the process	
	per vessel in g	in % from the control
150	128.89	28.30
250	419.55	91.21
350	465.44	100.00
450	319.61	70.15

A further increase of the number of revolutions of the stirrer produces an oppression in the synthesis of citric acid. The factor of stirring plays an important role already in the process of the initial growth and of formation of the acid-forming mycelia and thus decides a further success of the development of the acid forming ability which is inherent to this strain of the fungus. During an intensive stirring diffused mycelia are formed from the the germinating spores. During a slower stirring oval colonies, often quite condensed and of various sizes (from a small part of a millimeter up to several millimeters in diameter) are formed. Usually the large globular accumulations of mycelia, with a comparatively small

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surface of contact with the medium, are less active in the synthesis of acid.

Temperature also is a powerful factor, which influences the speed of growth of the forming mycelia, its metabolism and acid formation. At a lowered temperature the growth of the living mass of mycelia is retarded, and thus the process of acid accumulation in the solution is delayed. The researches have shown that the best temperature for the submerged process in obtaining citric acid equals 30-32°.

A further increase in temperature intensifies the growth of mycelia, yet their capacity to synthesize citric acid becomes lower. At that time the content of extraneous gluconic acid increases in the complex of acids in the fermenting solution, and the output of sugar also increases for the intensified process of respiration.

It is necessary to take into consideration that the submerged culture produces a considerable amount of heat. A cubic meter of the fermenting solution, with the culture of the fungus submerged in it, gives off per hour up to 2,500 of large calories of heat and thus, in order to avoid overheating, needs cooling.

All the conditions for the exclusion of infection are present when putting into practice the submerged method of fermentation. Yet, when the principle of sterility is violated, foreign bacterial and yeast microflora propagates very quickly, and the process of formation of citric acid almost always is depressed.

The researches have shown that the technology of reprocessing into the crystalline citric acid, the solutions which were fermented by the submerged method, does not differ from the technology of reprocessing the solutions, which were fermented by a surface method [5].

On the basis of such thoroughly conducted scientific researches, a

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new technology for the production of citric acid by the submerged method was developed, and its appropriate technological outfitting produced. The new technology was approved on the semi-production [pilot plant] installation at the Leningrad Factory of Citric Acid, where later on, in 1953, a shop for the submerged fermentation was established and the submerged method for obtaining citric acid was successfully introduced into production. [Begin p.339].

We cite briefly the technological scheme for production of citric acid by the submerged method (figure 7).

Title of figure 7. A technological scheme for obtaining citric acid by a submerged method (explanation is found in the text).

For the preparation of the nutritive medium a sugar syrup is prepared in a digester (1), which is then pumped over through a filter (2) by a centrifugal pump (3) into the apparatus for sterilization (4). After the introduction of syrup into the sterilizer the necessary nutritive salts from the dissolving apparatus for salts (5) are also fed into it. The prepared nutritive medium is sterilized under pressure and is transferred along the sterile communication system into the sterile fermentation tanks - fermentors (6). Then the nutritive medium, cooled to 32-34°, is seeded with conidia of the fungus, strain no. 82 (D) from the inoculating apparatus (7) or with the previously germinated mycelia (from a special fermentor for germination).

After the seeding, sterile air is introduced along sterile air lines for the aeration of the submerged culture in the fermentor. The air is delivered by a compressor (8), and before entering the fermentor is sterilized by passing through an antibacterial filter (9). Stirring the submerged culture of the fungus is done by "barbotirovaniia" [atomization] of air and utilization in the fermentor of a mechanical stirrer, which rotates at an assigned number of revolutions. The process proceeds at a temperature of

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30-32°. The fixed temperature of the fermenting mass is upheld by means of heating or cooling with water, which is passed through the jacket or a coil pipe in the fermentor.

After 8-10 24-hour days, when the accumulation of the titratable acidity stops, the fermented acid solution together with the submerged mycelia is poured from the fermentor into the steam chamber (10), where the mycelia are killed by boiling. Then the whole mass enters the filtering apparatus (11). The filtered acid solution is transferred into the accumulator (12), and the mycelia are additionally washed to rid them of the remaining acid. [Beginning p.340]. Acid solutions are reprocessed into the crystalline citric acid in the chemical shops of the plant.

Conclusions

Scientific research and results of the work on production according to the new technology have shown a high productivity of the process in obtaining citric acid by the submerged method, a (reduction in the output of sugar per ton of acid produced, a more efficient utilization of production areas, compared with the surface method, permitted increasing the production of the fermenting shops of the plant more than three times.

The submerged method for obtaining citric acid is based on the utilization of improved technics. It permits us to mechanize the labor-consuming works, to automatically adjust the technological process, which will lead to a considerable increase in the productivity of labor.

During the submerged method of conducting the process the losses from infection are sharply decreased and the total culture of production is heightened.

The submerged method has great possibilities for a further development

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of a new, progressive technology (improvement of conditions of nutrition and aeration of the submerged culture, improvement of the technological equipment, conversion to an uninterrupted process on the basis of utilization of the experience of other microbiological productions, and so on).

A positive solution of the problem about obtaining citric acid by the submerged method must be held as a new, serious contribution to the work of a further development of the native industrial microbiology.

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Novoselova, L. V., Shilova, A. V., and
Rumba, A. A.

Novaia tekhnologiia prigotovleniia posevnogo materiala v proizvodstve limonnoi kisloty.

[New technology for the preparation of seeding material for the production of citric acid].

Vsesoiuzn. Nauch-Issled. Inst. Konditerskoi Promysh. Trudy, vol. 11, p.136-139. 1955.
389.9 T78

(In Russian)

Setting up of a guaranteed seeding material reserve appears to be the basis for every biological production. This refers especially to the obtaining of citric acid from sugar containing raw materials with the aid of the mold fungus Aspergillus niger, which received its production realization only comparatively recently (20 years ago).

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The technology for the preparation of the seeding material at the acting citric acid plants consists in obtaining a hydrous spore suspension from live sporogenous films of the mold fungus, Aspergillus niger, grown on a liquid nutrient medium in closed metallic flat vessels (Protod'iakonov's flask). The sporogenous fungous films are grown on wort medium at a temperature of 32° in the course of 5-6 days, after which they are transferred to conditions of reduced temperature (10-15°) and kept there up to the moment of their utilization. At the reduced temperature the metabolic processes of fungi slow down somewhat and the films can be stored for a period of 7-12 days. A longer storage leads to autolysis of the mycelium, and the sporogenous surface of the film becomes coated with the secondary mycelium owing to the growth of spore heads. Thus, at a lengthy storage of sporogenous films a considerable part of the spore yield is lost, and the my-

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celium becomes fragile and easily disintegrates when the spore suspension is prepared, which causes difficulties during filtering.

The existing technology for obtaining seeding material has many defects, among which the most important is the impossibility to create a guaranteed reserve of spores for the production, as the hydrous spore suspension can be stored for not more than 3-4 days. This circumstance impedes a preliminary control of the final stage of the propagation of the seeding material, which is used for seeding in the fermentation chambers. Besides this, the storage of sporogenous fungous films in those vessels where they were grown, makes it necessary to have a large stock of production vessels, as well as aspace for their storage at lowered temperatures.

It is known from literature, that mature conidia of mold fungi, which are separated from the mycelium retain for a long time 6-10 years the ability to germinate and form a mycelium, which possesses the properties of the initial culture [1].

The scientific-research laboratory at the Leningradskii Citric Acid Plant for many years was occupied with the solving of the problem [Begin p.137], about the formation of a guaranteed reserve of spores in the form of mature conidia, separated from the sporogenous culture of the production strain.

As a result of this research it was established that:

1) it is possible to store mature conidia of the fungus Aspergillus niger for a period of 1-2 years whereupon the germination of the spores was 70% and the activity of acid formation was not lower than that of the initial culture of the fungi;

2) the temperature conditions for the storage of "dry" spores lie in the range of + 25 to - 25°.

A method for obtaining "dry" spores was developed, which could be ap-

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plied to production conditions. This method consists of the following: sporogenous film of Aspergillus niger is grown on a nutrient medium in special vessels (cuvettes), which are adapted for a subsequent drying of the film by a current of sterile air, which is heated to 35-40° and is passed underneath the film. The spores are collected from the dried film onto a filter, made of silk cloth and placed into a special nozzle which is connected to a vacuum-pump. The dry spores, which settle on the filter, are poured out into sterile boxes or jars with ground stoppers and are placed into a desiccator to be kept there until utilized.

In the following works (laboratory of VKNII, 1953) devoted to the problems of introduction of "dry" spores into production, details of the conditions are given for obtaining and utilization of dry spores, such as: setting up the needed apparatus for this method, temperature and length for drying off the mycelium, norms for collecting conidia of different strains from a unit of area (strain 6/5 - 35-40g, strain 90-100g from 1 sq. m.), method and norms of seeding the dry spores in the fermentation chamber (20-30 mg per 1 sq. m.).

At the present time dry spores are obtained by the above-cited method, under production conditions, at two citric acid plants, which are working on various forms of sugar stock with two different strains of Aspergillus niger; the Leningradskii Citric Acid Plant works with strain 6/5, using sugar of industrial grade, while the Rizhskii plant obtains citric acid from molasses with the aid of strain no. 90.

Small aluminum cuvettes, the area of the bottom of which is 9-10 sq. dm [decimeter], are utilized as vessels for the growing of sporogenous films. Drying of the films is conducted in small cases, where sterile air is heated electrically (exchange of the air is 30-40 L. per min), in the course of 4-6 hours. The process of gathering the conidia from dried films proceeds very

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fast and is accomplished in a sterile bench box where sterile air is supplied under pressure in order to avoid a drawing under during the work of the vacuum pump.

A microbiologist gathers 6-10g of dried spores during one hour. The collected yield of spores from 1 sq. m. reaches the following amounts.

Leningradskii plant - strain 6/5 (Shilova, Novikova, Polotskaia) - 21.5 to 47.1g, on the average 33.5g per 1 sq. m;

Rizhskii plant -strain 90 (Rumba, Gailis, Agafonova) - 81.5 to 110g, on the average 100g per 1 sq. m.

Thus, at the Rizhskii and Leningradskii plants there is formed a guaranteed reserve of seeding material in the form of dry spores, whereupon the gathered amount of spores for the Rizhskii plant already constitutes a half-yearly requirement for all production chambers. At the Leningradskii plant, where a less sporogenous strain is used, the gathered amount of dry spores guarantees a simultaneous seeding of 8,000 sq. m. of the fermenting area, which comprises almost a two-week requirement for the acting fermenting area.

The gathered dry spores are tested for their activity in acid formation, for uniformity, and after that they undergo production tests in fermentation chambers.

During the year 1953, and up to the present time, in the experimental chamber of the Deringinskii Citric Acid Plant, where the area of each cuvette is 6.3 sq. m, production [Begin p.138] tests (L. F. Sandler) are conducted on fermentation of molasses with dry spores of the strain 90 (by the continuous method), with a high layer of solution (concentration of sugar in molasses was 15-17%).

Seeding of dry spores is conducted through the general air-feed with a distribution for each cuvette with the aid of a current of sterile air. For

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each 1 sq. m of fermenting solution 60 mg of dry spores are sown. The formation of the fungous film proceeds there so energetically that after seven days almost all the sugar in the molasses is fermented. The yield from 1 sq. m constitutes in separate cycles from 680 to 1,088g of citric acid per day, and when the layer of solution is 12 cm thick the yield increases to 1,440g of citric acid.

Title of the figure: Requirement in the seeding material for seeding 100 sq. m of the fermenting area: under conditions of the acting technology (1); when utilizing dry spores (2).

Production tests of dry spores, strain 90, are also conducted on the Rizhskii Citric Acid Plant since 1953 in three fermentation chambers. It is obtained there from 1 sq. m of the fermenting area (when the layer of solution is 8 cm thick) from 890 to 1,095g per a 24-hour day, and up to 1,200g per 1 sq. m with a layer of molasses 12 cm thick.

At the Leningradskii Citric Acid Plant dry spores of strain 6/5 are tested on sugar solutions utilizing a multi-changeable method of fermentation. Three production cycles were conducted with the seeding of dry spores on the surface of a nutrient solution.

Dry spores, in a proportion of 25-30 mg per 1 sq. m of the fermenting area, were taken for seeding. A very energetic and uniform formation of mycelium occured even during the first day, and the film, in its outer appearance, was ready for the change of the nutrient medium much earlier than usually. The yield from one sq. m in these experiments, at a 15-16 day period of fermentation, reached 470-570g per day with a yield from sugar of 32-39%. A seeding of dry spores of the strain 6/5 in the form of spore suspension (into the depth of the solution) was also tested. The number of dry spores, utilized for the seeding of the chamber (area 120 m^2), was 5 times greater than for the surface seeding. This amount of spores, nevertheless, constituted only 1/4 part of conidia which are used for the usual

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seeding according to the old technology. A very fast formation of a fungous film was also noted in this experiment. Ten hours after seeding a continuous web of mycelium was formed over the whole surface of the solution.

Experiments with the surface seeding of dry spores of strain 6/5 on the sugar nutrient solution have clearly demonstrated a great economy in the expenditure of spores when the new technology for the preparation of the seeding material was introduced. Instead of 15-20 of sporogenous films, which were needed for the preparation of the hydrous spore suspension for seeding in the fermentation chamber of an area of 120 sq. m, for seeding by the surface method of a similar area only 3-3.5g of dry spores are required, which are gathered from a single aluminum flask (see the figure). [Begin p.139]

Conclusions

The new technology for the preparation and use of the seeding material in the form of dry spores has many advantages over the existing technology, and consists of the following:

1) a preliminary control of the prepared seeding material is easily accomplished, which was not possible with the old technology;

2) it has become possible to store the prepared seeding material for a long time, and thus create a guaranteed reserve in the form of dry spores;

3) the storage of the guaranteed reserve of dry spores does not require large holding capacities and special temperature conditions;

4) a convenience in transportation of dry spores creates a real possibility for the centralization of supply of the seeding material for all citric acid plants;

5) use of the surface seeding with dry spores reduces 15-20 times the expenditure of the seeding material.

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The fast tempos of development of the citric acid branch of production emphasize especially sharply the need for the quickest solving of the problem for the organization of production of dry spores *Aspergillus niger* in the form of a central spore station, which will supply all the existing and the newly constructed citric acid plants with the guaranteed sowing material (1).

Footnote (1) During the time of publication of this article, the cited method for dry spores and their utilization was introduced in Leningradskii and Rizhskii citric acid plants; now they are utilizing dry spores exclusively.

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Zhuravleva, E. I.; Grinfel'd, D. G., and
Karklin'sh, R. Ia.

Ratsional'naia tekhnologicheskaia skhema proizvodstva limonnoi kisloty iz melassy (1).

[Rational technological scheme for production of citric acid from molasses].

Vsesoiuzn. Nauch.-Issled. Inst. Konditerskoi Promysh. Trudy, vol. 11, p.129-135. 1955.
389.9 T78

(In Russian)

In the practice of the work of the citric acid plants, two basic surface methods are known for the production of acid from molasses. One, which was utilized by the Rizhskii plant consists in that the film of the fungus

Footnote (1). This work was carried out by the biochemistry laboratory of VKNII [All-Union Confectionery Scientific Research Institute] together with the associates of Deriuginskii and Rizhskii plants producing citric acid.

The following persons took part in the work: from VKNII - V. V. Aleksandrov, T. S. Deviatova, L. V. Novoselova; from the Deriuginskii plant - L. F. Sandler, A. L. Kovaleva, E. A. Teterevlatnikova, P. I. Proskuriakova; from the Rizhskii plant - V. F. Agafonova, A. A. Rumba, A. Proboks, A. Paegle, V. K. Gaile.

Results of experiments are given in the article. At the present time this scheme has been introduced into the Rizhskii plant for citric acid production where the work, conducted according to the new method, gives an average yield of 800g of citric acid per day from a square meter of the fermenting area.

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Aspergillus niger is first grown on a sugar nutrient medium, which later on is replaced by a specially treated molasses solution; this again is renewed as the fermentation proceeds. The change of the solution under the film is made 4 to 5 times. The height of the layer of the solution is 2 cm.

With the second method, which has found its utilization in foreign refineries [1,2,3], the process is conducted with a permanent, or continuous culture. The growth of the fungi and the fermentation are conducted on one and the same molasses solution with a height of 8 cm of the fermenting layer. The characteristic peculiarity of the second method is the seeding of dry spores on the surface of the solution and a continuous exchange of air in the chamber, which is produced by blowing sterile air over the surface of the fungus film.

During work with the multichangeable method at the Rizhskii plant the average daily skimmings of citric acid from a square meter of the fermenting area equal 350g. The yield of citric acid amounts to about 25% of the introduced sugar of the molasses.

With the work by the continuous method, as one can judge from some indirect data cited in literature [1,2,3], skimmings of citric acid reached 650g from a square meter of the fermenting area per day, and the yield - 60% of the utilized sugar in the molasses.

The comparison of the two methods, which was conducted under laboratory conditions, also showed a great advantage of the permanent method with the utilization of high layers of the fermenting solution. That is why further work of the associated workers was directed to the study of this method; first to master it, and later on in order to intensify it.

We had two strains at our disposal, which were adapted to the conditions of work with molasses (stain 82 and 90 (2)]

Footnote (2). the numbering is given in conformity with that which is used in the museium of pure cultures of VKNII.

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Both strains, under certain conditions of work on molasses are highly active acid formers. [Begin p.130] Yet, as it was found out, strain 82 is much more sensitive to a difference in the composition of molasses, and that is why it gives better results when it is used in the work on a limited number of batches of molasses. On the basis of this we chose the strain 90 for the work. In all laboratories and in factory experiments for surface seeding on solutions we utilized the dry spores, which were prepared according to the method of Novoselova and Protod'iakonov.

The fermenting force of various specimens of molasses.

We tested 35 specimens of molasses; among them 24 specimens from 11 sugar refineries of the Kurskii Beet-sugar Trust produced in the years 1951/52, 1952/53 and 1953/54, and 10 specimens for the same years from Latvian sugar refineries. The obtained data showed a good fermenting force in the greater part of tested molasses specimens. The yield of acid per day from each square meter of the fermenting area was for them in the limits of 700-1,300g, comprising 60-66% of the sugar content.

Only one specimen, from among the tested ones, did not ferment (molasses from the Deriuginskii refinery, produced in 1952/53, which was obtained from frozen and spoiled beets by an unsettled technological process of continuous diffusion of Kundjulian), and three other specimens showed a low fermenting force. The poor yields, which were obtained from the three specimens, relate to molasses which were produced during the end of the operating period, and one of them during the work with Kundjulian's diffusion. Until the present time we could not yet find out the dependence of the fermenting force of molasses on their chemical composition. This will be investigated further.

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Certain results of the laboratory work on the intensification of the process.

Investigation of the problem of the influence of sugar concentration in the fermenting solution on the intensity of acid formation during the work with molasses by the continuous method has shown that for the greater part of tested specimens of molasses, when the concentration of sugar was increased from 15 to 17.5-20%, the skimmings of acid from the fermenting area increased 15-40%.

Moreover, the output of molasses increased insignificantly, and in certain cases, when the greatest increase of skimmings during the growth of the concentration of sugar was noted, its output even decreased.

We investigated the question of influence of the height of the fermenting layer during the continuous culture on the intensity of the process.

The height of the layer was changed in the limits of 3-8 cm and 8-25 cm; and it was ascertained that, with the lowering of the height of the layer to 3 cm, skimmings from the fermenting area decreased by 50%, compared to the skimmings which were noted at an 8 cm height of the layer; lowering the layer to 4 cm gives a decrease in skimmings to 30%, and at 5 cm to 25-20%. The increase of the height of the layer of the fermenting solution above 8 cm brings a further growth in skimmings, which increased especially for certain specimens of molasses with a periodical stirring of the solution under the film. In individual laboratory experiments skimmings of acid from 1 sq. m came up to about 1,900g per a 24-hour day.

A technological instruction on the treatment of molasses and on the conducting of the process of fermentation was worked out on the basis of the conducted laboratory experiments; the factory experiments were then begun according to these instructions.

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Results of factory experiments at Deriuginskii refinery.

An experimental set-up for the production of citric acid from molasses by a permanent method of cultivation on high layers was outfitted on Deriuginskii refinery. [Begin p.131].

The general scheme of the set-up is given in figure 1. Molasses are kept in enameled tanks 1 (holding capacity of each is 5 cub. m.); from there it enters by gravity the tank where syrup is boiled, and which is found in the general plant's syrup station. Its holding capacity is 1 cub. m. Molasses, which are somewhat diluted and heated, passing through a trap 3, for the extraction of mechanical admixtures, are drawn by a pump 4 along special piping made of acid-resisting steel to a sterilizer of the experimental set-up 5.

Title of figure 1. Technological scheme of the experimental set-up in the Deriuginskii refinery:
1- storage tank for molasses; 2- syrup boiler; 3- trap; 4- centrifugal pump; 5- sterilizer; 6- fermenting chamber; 7- "formalinnik" [receptable for formalin]; 8- apparatus for the inflow of air for ventilation; 9- storage tank for the fermented solution.

Words in the figure: ________ product line
---------- steam line
-.-.-.-.-.-. water line

Total holding capacity of the sterilizer is 3 cub. m., it is equipped with a stirrer, which is doing 15 rev/min, and spiral tubes for the supply of steam and water. The sterilizer is connected, by a pipeline, to the filling system of the fermenting chamber.

In the fermenting chamber there are two racks with 7 vessels in each one. One rack is equipped with iron vessels, coated with Rubrax. The experiments were not conducted on this rack. The vessels of the second rack are made of acid-resisting steel, EIa-1T brand, and their borders are built up.

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The size of the vessels is: length 3.5 m, width 1.8 m, surface 6.3 sq. m. Height of the borders is 12 cm.

The chamber is equipped with an inflow ventilation system (see figure 1) with a feed of sterilized air over the vessels.

The tank has a holding capacity of 1.5 cub. m; it is graduated and serves as a measuring tank for the fermented solutions. The solution is then pumped over into the chemical shop into the general storage tank.

Twelve cycles of fermentation were conducted in the experiment chamber; five different batches of molasses were tested. The process of treatment for each batch was established separately in the laboratory (concentration of sugar, dose of sulfuric acid, of potassium ferrocyanide of phosphoric acid) and was used subsequently.

In all the experiments dry spores of strain 90 were utilized, which were obtained by the microbiologist of the Institute, L. V. Novoselova. The seeding of the spores on the surface of the solution in the vessels was accomplished by introducing them through the ventilation system.

In all the experiments, including no. 10, the height of the solution was 8 cm, and in experiments no. 11-13 - 11.5 cm. [Begin p.132].

Results of the factory experiments at the Deriuginskii plants are cited in table 1. In columns 2,4,6 are given average indicators for the chamber, and in columns 3,5,7 - the best obtained in the same cycle in different vessels (1).

Footnote (1). Observations were conducted for each vessel separately.

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Table 1.

Results of the work of the experimental chamber in Deriuginskii refinery

No. of the cycle	Skimmings of citric acid in g/sq. m per 24-hour day		Yield of citric acid in % from the sugar		Output of sugar for 1 t of citric acid in fermented solutions in t	
	average for the chamber	maximum for a vessel	average for the chamber	maximum for a vessel	average for the chamber	maximum for a vessel
3	318	-	22.7	-	4.4	-
4	-	953	-	62.3	-	1.90
5	598	1010	38.0	61.9	2.62	1.61
6	545	599	43.5	48.0	2.32	2.08
7	621	800	52.4	67.5	1.90	1.48
8	674	761	32.9	37.9	3.04	2.64
9	744	-	44.0	-	2.27	-
10	1088	1307	54.8	59.4	1.83	1.68
11	1440	1675	56.4	66.4	1.77	1.51
12	1331	1494	52.6	57.2	1.90	1.74
13	1365	1672	53.1	64.4	1.88	1.55

Results, cited in table 1, show that starting with the 3rd cycle, the skimmings of citric acid increased, and in the no. 10 experiment, when working with a layer 8 cm high, they reached 1088g per one 24-hour day from a sq. m. of the fermenting area. Increase of the height of the layer in experiment no. 11 to 11.5 cm, when working with the same molasses, gave a growth in skimmings of citric acid from 1 sq. m. of the fermenting area up to 1440g per 24-hour day with an expenditure of 1.77 t of sugar in the molasses per 1 t of acid.

High yields of acid were also obtained in experiments 12 and 13, which were conducted with other molasses at a height of the layer of 11.5 cm.

Data of observations of the yields obtained in separate vessels in the experiment cycles are also of great interest. They give an opportunity to judge about the future possibilities of this method. Already in the fourth cycle, on one of the vessels skimmings of the acid reached 953g, which was later substantiated by experiments at the Rizhskii and Deriuginskii re-

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fineries. During the 10th cycle, with an 8 cm layer, on one of the vessels the skimmings reached 1,800g, and with the 11.5 cm height - 1,675g.

These figures point to the further possibility for an increase in the average skimmings when conditions for a uniform and a most favorable air regime will be established.

Results of the factory experiments at the Rizhskii refinery.

One production chamber with one rack was re-equipped for the work with high layers for a changeless method of cultivation. The schematic drawing of the experimental chamber is given in figure 2.

In this chamber a fermentation was systematically conducted according to the technological instruction, which was drawn up on the basis of the first experimental cycles conducted in the Deriuginskii refinery. The work was done with dry spores of strain 90, which was prepared in the refinery according to the method of Novoselova - Protod'iankonov. The amount of sterile air, which was supplied into the chamber, guaranteed an 8 to 12-fold exchange.

Twelve cycles of fermentation were conducted in the experimental chamber; their results are cited in table 2. [Begin p.138].

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Table 2.

Results of the work of the experimental chamber at the Rizhskii refinery

No. of the cycle	Skimmings of citric acid in g/sq. m. per 24-hour day	Yield of citric acid in % from sugar	Output of sugar per 1 t of citric acid in fermented solutions in t	Remarks
1	890	46.5	2.15	
2	1095	52.5	1.91	
3	985	41.0	2.44	
4	1020	47.2	2.19	
5	915	44.1	2.27	
6	940	39.2	2.55	
7	1045	44.0	2.24	
8	1032	42.8	2.34	
9	970	37.7	2.76	
10	615	29.3	3.42	A curtailed exchange of air on account of a defect in the ventilation system
11	635	33.4	3.2	
12	1200	46.2	2.16	
13	990	40.0	2.50	
14	1260	47.6	2.10	
average	961	41.2	2.43	

As it is seen from table 2, the skimmings of citric acid from 1 sq. m of the fermented area in all cycles, except 10 and 11, were in the limits of 900-1,200g/24-hour day. In cycles 10 and 11 the exchange of air was insufficient (triple), which decreased the skimmings to 600g.

Title of figure 2. Scheme of the experimental chamber.

Words in figure 2, starting at the top:
air-pipe: According to A-B;
upper opening for air exhaust; nutrient line;
point of light; opening for air exhaust;
discharge line.
According to C - D
heater; remarks: details are not shown on the drawing.

[Begin p.134]

After that two more double rack chambers were re-equipped, which started

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to work according to the new method. The average data for each chamber separately during the time of work according to the new method are given in table 3.

Table 3.

Average indicators for the work of chambers, working with high layers and the continuous method.

No. of the chamber	Amount of cycles	Citric acid produced in kg	Average skimming of citric acid in g/sq. m. for a 24-hour day	Average output of molasses sugar per 1 t of citric acid in t
10	14	2072.0	961	2.43
11	8	1140.0	911	2.55
11a	8	1051.6	859	2.46
12	7	1104.0	853	2.59
12a	7	978.6	813	2.76
Total	44	6346.2	890	2.53

Into the average skimmings cited in table 3, are inserted all the cycles, including also those, which were conducted with a lowered exchange of air.

<u>Effectiveness of transfer of Deriuginskii refinery to the work with molasses according to the new technological scheme</u>

An increase in skimmings of citric acid from the fermenting area was achieved with the conversion to production of citric acid from molasses with the work done by a continuous method in high layers. During the existing method of work on sugar the average daily skimmings of citric acid at the refinery from 1 sq. m. of the fermenting area for 11 months in 1953 constituted 352g. On the basis of the work of the expermental chamber with molasses according to the new technological scheme, the skimmings of acid are established at 700g for the compilation of the reconstruction project, with a possibility in the future to achieve 1,000g.

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With a daily skimming of 700g with an available fermenting area of 5,200 sq. m, the yearly capacity of the refinery will be increased two times and will reach 1,000 t.

Simultaneously with this, with the conversion to the work with molasses, an increase is reached in the yield of citric acid from the expended sugar, and, correspondingly, the expenditure of sugar is lowered. At the present time for 1 t of the acid 3.74 t of crystalline sugar is spent; when working with molasses the expenditure of the molasses sugar will be only 2.2 t.

The average yearly economic effectiveness for the refinery with a conversion to the work with molasses will constitute 27,110 thousand rubles.

Basic indicators of the technical-economical effectiveness of the conversion of the Deriuginskii refinery to the work with molasses are cited in table 4.

Table 4.

Basic technical-economical indicators of effectiveness of conversion of Deriuginskii refinery to the work with molasses.

Name of indicators	Unit of measurement	With the existing scheme	Working with molasses
Productivity of the plant per year	t	500	1000
Expenditure of sugar per 1 t of acid	"	3.74	-
Expenditure of sugar per year	"	1870	-
Expenditure of molasses per 1 t of acid	"	-	4.6
Expenditure of molasses per year	"	-	4600
Skimmings of citric acid from 1 sq. m. of fermenting area per 24-hour day	g	352	700
Expenditure of fuel per 1 t of acid	t	21.82	16.0
Expenditure of manpower	man-days	125.6	95.4
Cost price of 1 t of citric acid	%	100	84

[Begin p.135]

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Effectiveness of transfer of Rizhskii plant to the work according to the new technological scheme.

The Rizhskii plant for citric acid production worked by utilizing molasses in a multichangeable method with low layers. Its transfer to the work according to the new scheme will bring about a double increase in productiveness of the plant, as well as a considerable reduction in the expenditure of molasses.

The basic technical-economical indicators of effectiveness in the transfer of the plant to the work with a permanent method of fermentation with high layers are cited in table 5.

Table 5.

Basic technical-economic indicators of effectiveness of transfer of Rizhskii plant to the work with the permanent method

Name of indicators	Unit of measurement	With the existing scheme	Utilizing the permanent method
Productivity of the plant per year	t	57	100
Expenditure of molasses (46%) per 1 t of citric acid	"	9.08	6.0
Expenditure of molasses per year	"	517.6	570
Expenditure of sugar per 1 t of citric acid	"	0.27	-
Expenditure of sugar per year	"	15.39	-
Skimmings of citric acid from 1 sq. m. of fermenting area per a 24-hour day	g	346	700
Expenditure of fuel per 1 t of citric acid	t	19.6	16.0
Cost price of 1 t of citric acid	%	100	68

Conclusions

High yields of citric acid were obtained in laboratory and plant experiments at the Deriuginskii and Rizhskii plants when work was done with molasses in high layers and with changeless culture.

Stable average daily skimmings of acid of 900-1,000g from 1 sq. m of the fermenting area, with a yield of 50-55% of the molasses sugar, were

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reached under plant conditions.

The obtained skimmings exceed two times those obtained now with the work on sugar, which will permit doubling the output of the acting plants.

Release of a considerable amount of sugar for the consumption of the population will become possible after a transfer to the production of citric acid from molasses.

Reduction of the cost price of 1 ton of acid by almost 60% was achieved through the change from sugar to molasses, with a simultaneous doubling of the output of citric acid by the plant.

The conducted work gives sufficient reason to recommend that all citric acid producing plants, which are using the surface method, change to the work with molasses.

<u>Literature used</u>

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(In full)
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Pisarev, V. E., and Zhilkina, M. D.

Kukuruza Podmoskovnaia.

[Podmoskovnaia maize].

Selektsiia i Semenovodstvo, vol. 21, no. 3, pp.51-53. 1956. 61.9 Se5

(In Russian)

We began maize selection work in the year 1950. In this unfavorable year, as regards conditions of vegetation, ears matured on only 30% of the plants of the earlier ripening Siberian maize varieties; Sibiriachka, [Siberian] Minusinka, Beloiaroe psheno [White Spring Millet] and others. In the non-chernozem belt, the growth and development of maize proceeded in a peculiar manner. In the South, the leaves and stems dry up soon after the grain of maize has reached ripeness, yet in the varieties which succeed in maturing grain in the non-chernozem belt, the stems and leaves remain green and succulent and are entirely adequate for silage. Taking these characteristics into consideration, we endeavored to develop a maize variety that would mature grain, would grow sufficiently tall and would produce a good yield of green mass under conditions prevalent in the vicinity of Moscow.

Experiments have demonstrated that Siberian varieties would make valuable material for the production of varieties that would ripen in the non-chernozem belt. The plants of these varieties were, however, distinguished by low growth (from 60 cm up to 1 m) and, therefore, could not be utilized for grain and silage. [Begin p.52]

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In the spring of 1950 we crossed low-growing Siberian maize varieties with tall-growing southern varieties. The Siberian varieties were pollinated primarily with the pollen of the Kharkov Belaia Zubovidnaia [White Dent]. Maternal and paternal varieties were grown in a greenhouse. In that year the Kharkov Belaia Zubovidnaia maize seeded in the field did not even produce tassels.

The first generation of hybrids were seeded in 1951, a typical year as regards temperature conditions; their materanl varieties had been Minusinka Zheltozernaia [Yellow-grained Minusinka], Minusinka Belozernaia [White-grained Minusinka], Slavgorodskaia 270 [Slavgorod - Slav City] and Ranniaia [Early], and the paternal varieties Kharkovskaia Belaia Zubovidnaia [Kharkov White Dent] and Chakinskaia Zhemchuzhina [Chakinsk pearl].

We succeeded in selecting a considerable number of ears in the wax stage which completed their ripening in the laboratory. The results of the work, however, failed to satisfy us: contrary to our expectations, the height of the hybrid plants differed but little from that of the maternal early ripening varieties and did not exceed 137 cm. The ears were also set low; similar to those of the Siberian early ripening. The expected flare of heterosis was scarcely to be observed, apparently, in crossing the manifestation of the maternal inheritance was stronger. These observations gave us the idea that to obtain hybrid seed by crossing Siberian early ripening varieties with southern maize varieties, it would be more desirable to use southern varieties as the maternal forms.

[Illustration]: Maize ear of the Podmoskovnaia variety.

The same year we planted seed of the Dnepropetrovskaia varieties: 25, 26, 27, 28, and 29, and of the Severianka [variety] obtained from Prof. B. P. Sokolov.

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The plants of these varieties were sufficiently tall and they ripened under conditions of the Moscow Oblast; the Severianka variety which commenced ripening earlier than the others (September 12) was especially outstanding among them. However, under conditions of the Moscow vicinity, Severianka was far from a uniform population. The time of ripening varied in the plants considerably and the form of the ears varied also. It is interesting that the plants of the Severianka variety are short under conditions of the Dnepropetrovsk Oblast. Obviously, the plants acquired their height under the conditions of the Moscow vicinity as a result of having been exposed to the influence of a long day.

We used the comparatively early ripening, tall and large eared (up to 25 cm) Severianka variety as initial material in developing a maize variety for the Moscow Oblast.

In the years 1951, 1952, and 1953 the Severianka was cross-pollinated (open pollinated) with the hybrids previously obtained, their parental forms and with varieties from the Institute of Maize. From the population obtained, we, every year conducted a simultaneous mass selection of tall, early maturing plants with uniform ears, and with good productivity of grain and green mass. We named the variety population thus obtained the Podmoskovnaia.

According to 1953 data, the average height of the plants of the new variety was 166.4 cm (fluctuating from 134 to 210 cm), the ear was formed at an average height of 34 cm (from 24 to 48 cm) and its length averages 17.4 cm (from 11 to 29 cm). We note for comparison [Begin p.53] that the average length of ears of the hybrids [obtained from] Minusinka x Kharkovskaia Belaia Zubovidnaia was 14.6 cm, Pervenets [Firstling] - 12.4, the variety Dnepropetrovskaia 26 - 14.3 cm. That year Podmoskovnaia began to mature at the end of August and by September 20 65.7% of the ears had attained full maturity, the rest of the ears were harvested in the milk-wax

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stage.

In 1954, seed of the Podmoskovnaia variety from the 1953 selection were seeded on the Kolhoz imeni Makarov, Zvenigorodsk District, Moscow Oblast (experimental base of the Faculty on Darwinism of the Moscow State University). The summer and autumn of that year were considerably warmer than usually and 94.7% of the ears of Podmoskovnaia maize had matured in the second decade of September [Sept. 11-20]. In the case of the Voronezhskaia 76 maize, which had served as a standard variety in the experiment, 82.8% of the ears had ripened by the same time.

In developing Podmoskovnaia maize, we, apart from the usual selection, conducted in 1955 comparatively important work to determine the variation of such basic characteristics in a variety as the number of days from complete germination up to the appearance of male inflorescence and of stigmas in female inflorescence, height of the plants, height at which the ear is set and also the length of the ear. Three hundred sixty eight typical plants had been selected for this purpose. Three hundred plants were measured for mathematical analysis.

With regard to the vegetative period, Podmoskovnaia proved to be a fairly uniform population. The Coefficient of Variation - number of days from full germination until the emergence of stigmas - in female inflorescence amounted to 7%, and until the emergence of male inflorescence to - 10.8%. Coefficient of Variation of the height of plants of the new variety is also small - 6.32%.

As to the height of ear placement (31 cm), the new variety population proved to be very lacking in uniformity. The Coefficient of Variation for this character amounted to 72%. In the initial Severianka variety the average height of ears [on the stalk] was, on the average, 34 cm (from 24 to 48 cm).

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Lowering of the height of ear placement in Podmoskovnaia is due to the fact that the initial variety was cross-pollinated with short Siberian early ripening [varieties] and their hybrids; selection for this character was not conducted. In working with this variety in the future, it will be necessary to pay special attention to this economically important characteristic during selection. The Coefficient of Variation of ear length was comparatively high - 14.6%, therefore selection for ear length must also be continued.

Seed from ears selected in the year 1954 (absolute weight 228 gr. [1,000 kernels]) were planted in 1955 on the experimental plot of the Institute of Grain Economy together with those selected in 1953 (absolute weight = 234g.). The maize was seeded on May 23 using the 70 x 70 check-row method, leaving two plants in each hill. Immediately after the planting cold weather set in, and full germanation was noted only on June 15. Podmoskovnaia began to ripen during the first decade of September [Sept. 1-10]. On September 28, maize was harvested on a an experimental plot measuring 100 sq. m. The yield of green mass (stems, leaves and husks) of Podmoskovnaia on a hectare basis amounted to 161 centners, ears (without husks) to 59 centners; 67% of them attained maturity, the rest were in the milk-wax stage and in wax ripeness.

In 1955, Podmoskovnaia maize was seeded for propagation on the Kolkhoz imeni Makarov, Zvenigorodsk District, Moscow Oblast, and in the Volokolamsk experimental field.

Institut zernovogo khoziaistva tsentral'nykh raionov nechernozemnoi polosy. [Institute of Grain Economy of the Central Regions in the Non-Chernozem Belt]

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Kursanov, A. L.

Usvoenie rasteniiami uglekisloty
cherez kornevuiu systemu.

[Assimilation of carbon dioxide by
plants through the root system].

Akad. Nauk SSSR Inst. Fiziol. Rast. im.
K. A. Timiriaseva. Trudy, no. 10,
p.150-155. 1955 451 Ak16

(In Russian)

The subject touched upon in this report deals with the entry of CO_2 and of carbonates into the plant through the root system and thus, at the first sight, has no direct connection to the question of photosynthesis. Yet, it proved to be that carbon dioxide, which was absorbed by the roots, entered very rapidly into the composition of organic compounds without the participation of light, was transferred to the assimilating tissues and utilized there on a par with carbon dioxide from the air for the formation of sugars and of tother products of photosynthesis.

Since the time when the ability of green plants to assimilate CO_2 from the air was discovered, as well as to build from it the organic part of their bodies, the studies of this process proceeded almost entirely from the point of view of "air" nutrition of plants, without taking into consideration the possibility of entry of CO_2 or of carbonates from the soil through the root system.

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Insufficient studies of the problem of utilization of CO_2 from the soil led to a certain underestimation of the role of humus and of the biological processes in the soil for the crops, and as well served as a

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basis for a too biased an understanding of problems and of possibilities for utilization of mineral fertilizers. Meanwhile, direct experimental data, obtained for the last 20 years, show the possibility of entry of CO_2 to the leaves through the cut stems (Kuprevich, 1940) and through the roots (Bergamaschi, 1929; Overkott, 1938; Hörtel, 1939; Overstreet, Ruben, Broyer, 1940). Unfortunately, these works did not draw any due attention of botanists and of agriculturists and remained almost unknown.

Many soils, which are very rich in carbonates, and which also are characterized by an energetic microbiological activity, essentially are an inexaustible source of carbon dioxide. It is sufficient to remind, that in the soil air there is contained from 0.5 to 1.8% of CO_2, which is, on the average, 100 times more than in the free air.

The soil solution, especially with a neutral reaction, proves to be saturated with carbon dioxide under these conditions, and, consequently, contains about 1 L. CO_2 per each liter of solution. To this one should add the soluble and the insoluble carbonates, which increase many times the stores of CO_2 which are available to the plants; and it seems to me, that it is enough to recall an ancient school experiment with the corrosion of the polished surface of the marble by the plant roots, in order to become convinced of the availability of this source of carbon dioxide to the root system.

Would it not then be possible to examine from this point of view also the liming of acid soils, which in many cases tells so favorably on the yield, [Begin p.151] as a method, which is directed to the intensification of carbonate nutrition of plants through the roots?

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Issuing from all these considerations, we began, in 1951, a detailed study of the problem of nutrition of plants with carbon dioxide through the roots.

Already the first experiments (Kursanov, Kusin, Mamul', 1951) have shown that the 25-30 day old bean plants, whose roots were submerged into the nutrient solution with an addition of a small amount of $NaHCO_3$, absorb the carbonate with their roots and translocate it into the leaves and other organs, where CO_2, which entered through the roots, is utilised in the light in the process of photosynthesis. The "ozazony" [ozazoniums?] of sugars, which were isolated from such leaves, contained carbon isotope C^{14}, and this served as a direct proof of the availability to the plants of carbon dioxide. Yet, the nature of the cited phenomena needed further investigation and first of all a determination of the specific value of this source of carbon in the total nutrition of plants.

It would be quite natural to expect that the carbonates or the free CO_2 are sucked in by the roots together with the water and further on are carried away by the transpiration stream to the leaves. In order to prove this assumption we undertook some experiments, where for the same plants, whose roots were submerged in a solution of carbonates, simultaneously were calculated the amount of carbon dioxide, absorbed from the solution, and the amount of water sucked in (Kursanov, Kruikova, Vartapetian, 1952).

Examples are cited in table 1.

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Table 1.

Absorption of carbon dioxide by the roots from the solution and suction of water
(in mg for 90 minutes)

Sources of CO_2	Plants	Contents of CO_2 in 100 ml of solution	Absorbed CO_2	Water sucked in	Amount of CO_2 corresponding to sucked in water	Calculated $\frac{CO_2}{\text{Absorbed } CO_2}$
$NaHCO_3$	Beans - 15 days old	51.4	1.6	220	0.07	1:23
$NAHCO_3$		77.3	2.5	520	0.40	1:6
$NAHCO_3$	Sunflower - 20 days old	74.4	1.6	560	0.42	1:4
CO_2	Beans - 15 day old	58.1 84.1	7.9 5.3	260 210	0.15 0.18	1:53 1:29

Comparison of these values has shown that the amount of absorbed carbonate by the bean roots from water is several times higher than could be expected on the basis of the volume of the sucked in liquid. Absorption by the roots of free CO_2 dissolved in water proceeds, apparently, even faster. All this leads to an important conclusion that the absorption of carbon dioxide and of carbonates by the roots is an active metabolical process, which is not linked directly to the entry of water.

We utilized sodium carbonate and free carbon dioxide, containing C^{14}, for the calculation of the speed of movement of carbon dioxide in the plants. In the first case bean plants were immersed by their roots into a 0.02% solution of Na_2CO_3, which contained radioactive carbon in the amount of about 0.5 μ-C per 10 ml; in the second case the roots were placed in a closed atmosphere, which contained 3-5% of gaseous CO_2 with the same radioactivity. In all cases measures were adopted, which excluded a possibility [Begin p.152] of a free diffusion of $C^{14}O_2$ to the

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leaves through the surrounding air. The leaves remained illuminated, while the stem was shaded with tin foil. After different intervals of time from the upper pair of leaves discs were cut by a borer, and they were examined by a counting tube for the presence of tagged carbon. The obtained results can be illustrated by two instances which are cited in table 2.

Table 2.

Speed of entry of C^{14} into the leaves of bean plants through the roots (in counts/min per 1 disc)

Time, min.	Sources of carbon dioxide		Time min.	Sources of carbon dioxide	
	$Na_2C^{14}O_3$	$C^{14}O_2$		$Na_2C^{14}O_3$	$C^{14}O_2$
5	0	5	20	-	21
10	10	7	25	33	-
15	21	24	30	-	62

From these data it is seen that the speed of translocation of C^{14} along the plant is such that already in a few minutes after the contact of roots with the carbonate, and especially with CO_2, the carbon isotope is discovered (this phrase continues after table 3)

Table 3.

Distribution of C^{14} in 15-days old bean plants depending on the illumination of the stem*
(in counts/min per 1g of green weight)

Parts of plants	Stem illuminated	stem shaded
Stem	3170	1337
Leaf		
Lower	0	960
middle	360	1800
upper	0	2593

* Roots are immersed in a 0.025% solution of $Na_2C^{14}O_3$; duration of the experiment is 3 hrs.

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in the upper pair of leaves, that is, in the given case, at a distance of 18-20 cm from the roots. But the movement of CO_2, or of carbonates into different organs of the plant proceeds unevenly. In particular, if the stem contains chlorophyll (as, for instance, in bean plants) and is subjected to illumination, then the greater part of the moving carbon dioxide is "intercepted" by the green cells of the stem, without reaching the leaves. When the stem is shaded, the carbonates or CO_2 pass it unimpeded and rush mainly into the not quite fully opened pair of leaves, and only later on begin to accumulate in the grown leaves, which are situated beneath. In table 3 is cited an experiment with two bean plants, where one plant had an illuminated stem, and the other shaded with tin foil. [Begin p.168].

The accumulation of C^{14} in the illuminated stem is more graphically shown on the radicautographs, which are made from plants which received a carbonate with a tagged carbon through the roots, as in the foregoing experiment.

Title of figure 1. Radicautograph of 12-days old bean plants, which received $NaC^{14}O_3$ for 2 hours through the roots.
A- the stem is illuminated; B- the stem is shaded.

From figure 1 it is seen, that in a normally illuminated plant (a) the greater part of the heavy carbon is concentrating in the roots and in the middle part of the stem, which is the most rich in chlorophyll. C^{14} is found higher than this place in only insignificant amounts, mainly in the leaf petiole. When the central part of the stem (b) is shaded then the tagged carbon does not stop there, but reaches the leaves, where it accumulates in considerable amounts.

We do not know yet those tissues along which the carbonates or carbon dioxide, absorbed by the roots, are taking their course into the leaves. Yet, judging from radicautographs, this course does not proceed

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along the full thickness of the stem, but mainly along definite lines, corresponding to the course of the vascular-filamentous bundles.

Data, cited in table 5 and in figure 1, permit one to understand better the biological importance of chlorophyll, which is produced so constantly in the stems of many plants, notwithstanding the poor adaptability of the cutinised stems for the utilization of CO_2 from the surrounding air. In the light of the conducted experiments the role of chlorophyll in the stems must, [Begin p.154] probably, consist in the assimilation of CO_2, which enters through the roots, what undoubtedly saves the "transportation expenses" of the plant for the translocation of nutrients from the leaves into other organs.

The second, and probably not less important circumstance, connected with the presence of chlorophyll in the stems, consists in the formation of a large amount of oxygen during the assimulation of CO_2 within these organs. The vascular-filamentous bundles, which are enclosed into tissues wherein the air enters with difficulty, need this oxygen to uphold their rather intensive respiration (Kursanov and Turkina, 1952).

As it has been shown already (see table 1) absorption by the roots of CO_2 or of carbonates proceeds independently of the suction of water. At the same time, illumination of leaves sharply increases the flow of carbon dioxide to them from the soil. This can be illustrated by an experiment, which is schematically presented in figure 2, where the accumulation of C^{14} by bean plants was evaluated depending on the illumination of the leaves. For elimination of the competing activity of the stem in experiments with illuminated leaves, the stem was isolated from light (figure 2)[1].

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light (Figure 2)[1]:

Title of figure 2. Influence of light on the accumulation of C^{14} in 10-days old bean plants from the solution $Na_2C^{14}O_3$. Exposure - 2 hours. A - leaves are illuminated; B - Darkness. The figures correspond to the number of impulses per minute.

The mechanism of migration of carbon dioxide in the plant has not been studied fully yet; we also do not know those tissues along which it makes its course into the leaves.

Yet, we found out, that CO_2 or the carbonate, which is absorbed by the roots, almost instantly is converted, and without the participation of light, into some kinds of organic compounds, in the form of which CO_2 then makes its way to the assimilating tissues (Kuzin, Merenova, 1952; Kursanov, Krinkova and Pushkarova, 1953). The nature of these substances - conductors of CO_2 - begins to be cleared up. One can ascertain that in this case the introduction of CO_2 takes place in a nature of a carboxyl group into the organic acids which then move along the

Footnote (1). Later experiments have shown that in darkness the greater part of carbon dioxide, which enters the leaves from the roots, is thrown off by the leaf blades into the surrounding air. That is why on figure 2 one should have indicated the amount of CO_2 which is given off by the leaves. With such a correction the total amount of CO_2, which entered into the plant in darkness and in the light will prove to be not as different.

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plant. This makes it probable that carbon dioxide, which is absorbed by the roots from the soil, moves like the other organic substances along the phloem. The closest acquaintance with this form of organically fixed CO_2, which arises before the act of photosynthesis, can be of great interest also for understanding the dark phase of photosynthesis, which precedes the renewal of carbon dioxide.

Thus, the utilization of carbon dioxide by the plant from the soil appears to be quite a complicated physiological process, about the existence of which we did not know before. The specific value of carbon dioxide, which enters through the roots, can differ for the general metabolism and, in particular, for the carbon nutrition of plants depending on the conditions of existence, as well as on the kind and age of the plant.

Institute of Physiology of Plants
in the name of K. A. Timiriazev
of the Academy of Science in USSR.

[Begin p.155].

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File with Translation check index

Kursanov, A. L.

Usvoenie rasteniami uglekisloty
cherez kornevuiu systemu.

(Assimilation of carbon dioxide by
plants through the root system).

Akad. Nauk SSSR Inst. Fiziol. Rast. im.
K. A. Timiriazeva. Trudy, no. 10,
p. 150-155. 1955 451 Ak16

(In Russian)

This paper summarizes work on the entry of CO_2 or bicarbonate into the plant through the root system and its incorporation into plant tissues through photosynthesis or dark fixation. The findings result from the use of C^{14} enriched CO_2 and would appear to be reasonably well supported. The data accompanying this paper are somewhat scanty, but it is of the nature of a review with references to primary publications. The Soviet work seems to be largely original and not a duplication of studies elsewhere. This topic has been neglected by U. S. workers. Quantitatively, the phenomenon is not important, but physiologically it is of considerable interest. The rapidity of fixation of root-presented CO_2 is surprising. The suggestion that much of the CO_2 involved (in the photo-synthesis) in the epidermal tissues of the stems of plants may come from the root is novel. An unexplained feature of these phenomena is the mechanism of translocation or migration of CO_2. It is suggested that there is some type of dark fixation in the root to a metabolic intermediate which is then transported to the photosynthesizing zones.

A. G. Norman

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Trans. A-821
(In full)
vg/M

Arkhangel'skii, Pav. P.

O bor'be s golovnei na
tselinnykh zemliakh.

[About the control of smut
on virgin lands].

Zashch. Rast. ot Vred. i
Boleznei, no. 4, p.6-7.
1956. 421 Z1

(In Russian)

The infection of grain crops by smut fungus increased of late in the north-eastern oblasts of Kazakhstan.

Outbreaks in the growth of smut were marked before also, especially during the war years and the few first years after it, when the control of smut was neglected. In 1948, for instance, 116.6 thousand ha of grain crops were condemned on account of smut in the six north-eastern oblasts: Akmolinskaia, Karagandinskaia, Kokchetavskaia, Kustanaiskaia, Pavlodarskaia and Severo-Kazakhstanskaia, or 14% of the approbated area.

During the following years, owing to the systematic disinfections, as well as the introduction of smut-resisting varieties the infection of crops by this disease decreased, but then it increased again. Thus, if in 1952 2.2% of crops were condemned on account of smut infection, then in 1953 it was 4.88%, and in 1954 already 6.95%, or 150 thousand ha, and the amount of seeds which were infected with smut boils was double of that of the preceding year.

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Damage, which is caused by smut can be determined only approximately. If one assumes an average yield to be 10 c [centner = 100 kg = 220.46 lbs]

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per ha and the infection of plantings with smut at 5%, then the loss of grain from the full area of plantings in all six cited oblasts in 1954 will be 7.5 thousand c. But for this calculation only the approbated area was considered and the minimal percentage of infection was taken. The actual losses from the whole area of plants are, undoubtedly, several times higher. In 1954 the loss on account of smut comprised at least 200 thousand c of grain.

Yet no one is seriously occupied with the prevention of these losses.

In the six cited oblasts of Kazakhstan there are 1,283 kolkhozes. They are planting over 850 thousand t of seeds of grain crops, the time available for the treatment of these seeds is a little over one month because of the weather and other conditions before sowing time. In order to disinfect in the course of 30 days such an amount of seeds one requires 1890 seed treatment machines PU-1, taking into consideration their average daily productive capacity about 15 t. But actually there are only 455 machines available. And this number is certainly quite inadequate.

The same situation exists also in the remaining oblasts of the republic, and sometimes even worse. Here, for instance, is what the agriculturists of the Shemonaikhinskoi MTS, of the Vostochno-Kazakhstanskoi oblast', N. Efremov, S. Kuznetsov and T. Badulina write: ".... We have no resources to disinfect our seeds properly. Neither in kolkhozes, nor in MTS there are no special machinery. The seeds must be treated in ordinary barrels by hand, which leads to a great expenditure of man power, and often to a poor quality of disinfection. We asked repeatedly the Oblast' Department and the Ministry of Agriculture of the Republic to furnish us with the required number of machines for the disinfection of seeds, but nothing brought results".

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In 1955 for the 196 kolkhozes of the Vostochno-Kazakhstanskaia oblast(there were altogether 52 seed treatment machines PU-1, and during the last two years only 15 PU-1 machines were brought in.

What are the prospects for the mechanization of seed treatment work? Unfortunately, this problem did not find its full solution either in the work of the operative organizations, or in the scientific ones.

VIZR [All-Union Institute for the Protection of Plants] is constructing an attachment to a combine for the treatment of seeds. Will this fully solve the question about the mechanization of disinfection? Certainly not. Several MTS will make these homemade attachments and that will be all. A construction of a highly productive disinfection machine is needed. It would be best if a seed treatment machine was [Begin p.7] linked to the seeder. A quick release of highly productive seed treatment machines is needed.

The main Government Inspection on the Quarantine and the Protection of Plants of MSKh SSSR [Department of Agriculture of USSR] not only did not take a firm position towards science in requiring to build a needed disinfection machine, but also permitted the most powerful disinfection machine PU-1 to be taken off production of the Union factories and its production was entrusted to separate republics. One can judge of the results of this decision by the example of Kazakhstan.

Yet, in July 1953 the Soviet of Ministers of USSR entrusted the Soviet of Ministers of the Kazakh SSR to provide for a production in the republic of the seed treatment machines PU-1: 300 machines in 1953, 1,000 in 1954, and 1,000 in 1955.

The Soviet of Ministers in Kazakh SSR entrusted the Soviet of Industrial Cooperation with the organization of production of PU-1 in local workmen's associations. The Soviet of Industrial Cooperation charged the artel

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"Metallist" of the Djambul'skii Oblast' Production Soviet with this job. The artel, which did not have adequate equipment nor buildings for the production, after many discrepancies over the lack of metal and of parts (Gall's chain), and so on nevertheless mastered the production of PU-1. During the the next year production of machines was organised and 700 machines were shipped to different republics according to the order of MSKh SSSR. 340 machines were shipped to Kazakh SSR oblasts in 1955; during the first quarter of 1956 - 428 machines were shipped (those which remained undelivered from the 1955 plan.

Semi-homemade production was, of course, reflected in the cost of the machine, which was 700 rubles, whereas in 1950 this machine had a price of 580 rubles at the Union's mills (the price is given without the addition charged by Sel'khozsnab [Office of Agricultural Supply]).

In 1956, according to the annual plan of supply, no disinfecting machines were shipped to Kazakhstan - the Ministry of Agriculture of USSR forgot about them.

This is the situation with the disinfecting machines, and, as it is known, the dry seed treatment can only, be done properly by machines. It is no use even of speaking about disinfection by formalin under the conditions of planting on virgin lands of the north-eastern oblasts of the Kazakh SSR. Over 850 thousand t of seeds must be sown in a most brief time, the basic mass - during the course of 10 days. The organization of a moist disinfection and drying of such an amount of seeds during an extremely unsettled weather, which is usual for the spring period in the north-eastern oblasts, and in a period of 3-5 days before sowing - is a problem which cannot ofbe accomplished.

The chemicals for disinfection are not delivered annually in their full volume to the north-eastern oblasts. And every year after the end of plantings in the warehouses of Sel'khozsnab there are left considerable stocks of dis-

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infectants. The kolkhozes do not select any disinfectant materials, and those which buy in most cases conduct their disinfection by shoveling up the seeds and the disinfecting materials within the body of their cars, or in boxes of the seeders, and so on, which, in fact, is only an appearance of disinfection.

Treatment of seeds of all grain crops, as a basic link in the system for the control of smut, in view of such a situation becomes more and more discredited in the eyes of the members of kolkhozes and of agriculturists and already is not a required agricultural measure, as it was before the war or during the period of the first few years after the Great Patriotic War.

Such a situation is pregnant with dangerous consequences - with a sharp, all increasing infection of grain crop plantings by smut; a situation which we already observe.

What is it that can change the situation?

First of all, the attitude to the governmental system of measures for the control of smut. There should be given an actual authority to the governmental system. And, for this purpose, conditions must be created under which the seed treatment works can be filled in the necessary period of time and be of high quality. One must have an adequate number of highly qualified seed treatment machines and effective dry disinfectants. One must strive for an actual responsibility on the part of farm leaders for an accurate carrying out of the system of measures for the control of smut.

Secondly-regulation of seed growing. When the seeding area of each kolkhoz will be provided with healthy seed material, which is free of smut and which was grown under high agrotechnical conditions, one should assume, that the problem of control of smut will be solved very fast and with profit to the production.

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Administration for the Protection of Plants of the Department of Agriculture of Kazakh SSR.

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(Abstract)
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Kuchaeva, A. G.

Antibiotiki kak sredstvo bor'by s zabolevaniem vinogradnoi lozy mil'd'iu.

[Antibiotics in the control of grape mildew].

Akad. Nauk SSSR. Vest., v. 26, no. 12, p.53-54.
Dec. 1956. 511 Ak14V

(In Russian)

It was necessary, first of all, to find antibiotics which are able to depress fungi Plasmopara viticola. However, culture of the mildew's pathogen was not as yet obtained by anyone. Thus other means had to be found. They used the mycelium, which was formed on the leaves of the infected plants, for an artificial infection of the plants in order to cause, at will, mildew on healthy leaves of seedlings and of young plants of grapes, and then to select the antibiotics which will protect the plants from mildew.

A further problem was to find a way to introduce the antibiotics into the grape cuttings and leaves. The following antibiotics were tested: streptomycin, penicillin, syntomycin, "levomitsitin [levomycetin?], terramycin, biomycin (the pure preparations) and antibiotic no. 1609, which is a preparation that was obtained in the Institute of Microbiology from a culture of actinomycete. Besides this, other antibiotic substances were tried in their native state, in the form of cultural liquids from different kinds of actinomycetes; and those most active of them in the fungi spectrum (no. 1669, no. 2286 and no. 2739) were taken into research.

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As a result of the conducted investigations it was found that from an

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aqueous solution all the above cited antibiotics enter easily into the grape cuttings with the exception of syntomycin and no. 1609.

After it was ascertained which of the antibiotics were easily absorbed by the tissues of grape vines and did not produce any toxic action, a series of experiments was conducted in the use of antibiotics to control mildew.

Three series of experiments have shown that penicillin and the native antibiotic no. 2739 protect the plant from mildew. Plants, which were treated with these antibiotics were not infected with mildew.

Experiments were also conducted to determine if mildew could be cured. Leaves, with an initial stage of disease, when there were spots but no conidia yet, were submerged by their stems into the antibiotic solution for 5 hours, then they were removed and placed into the moist chamber of the oven for 2-3 24-hour days at 24°. The effect was evaluated according to the development of conidia on the leaves.

It was ascertained that terramycin, biomycin, syntomycin, and the native liquids from actinomycetes no. 1669 and 2286 did not interfere with the formation of Plasmopara viticola fungi conidia. Streptomycin, levomycetin and no. 1609 retarded somewhat the formation of conidia on the grape vleaves, but still some of them appeared on the down side of the leaves. Whereas on the leaves which were treated with penicillin and no. 2739 conidia did not develop, the process was checked.

The obtained results permit to make a conclusion that some antibiotics, and, in particular, penicillin and the actinomycetes preparation no. 2739 can be an effective means for the control of mildew on grapevines. The fact, which was previously established by the Institute of Microbiology, that antibiotics can enter into the plants not alone through the root system, but also through the aboveground organs, has facilitated this problem considerably.

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Lobanov, P. P.*

Vazhnye voprosy nauki i praktiki.

[Important problems of science and practice].

Nauka i Peredovoi Opyt v Sel'sk. Khoz. no. 7,
p.4-7. July 1956. 20 N222.

(In Russian)

In the light of decisions of the Twentieth Convention of the Communists Party of the Soviet Union on the activities of scientific institutions in the further development of agricultural science, the problem about a development of a system of farming according to different zones of our country acquires a special importance. It requires an urgent decision so as substantially to help kolkhozes and sovkhozes to really increase production of all kinds of agricultural products for one hundred hectares of land with the least expenditure of labor and money.

Thus, before agricultural science stands a problem to work out a scientifically based system of farming which can be applied in basic natural - economic zones of our country. The criterion for its real scientific and practical usefulness will be an absolute fulfillment and overfulfillment by each kolkhoz of assignments on the delivery and sale of products to the government, and production of such an amount of products, which will fully satisfy the needs of every kolkhoz in their own provisions of grains, forage, seeds and in building up the needed surpluses on the farm.

*Footnote: An abbreviated shorthand report of his public address at the All-Union Conference of the Workers in Agricultural Science.

[P. P. Lobanov is the President of the All-Union Academy of Agricultural Sciences im. V. I. Lenina].

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The richest material has been accumulated in the arsenal of agricultural science and of the leading practice; a scientific analysis of them permits working out and recommending to the industry the most effective system of measures suitable to each natural - economic zone. This is their next and most important problem. It does not exclude, but on the contrary brings to the fore a requirement to all institutes and to the experiment stations to conduct deep theoretical research, to accumulate new experimental data as a basis for a scientific development of methods for a further progress in our rural economy, to expand the science and to push it forward.

It is known that our country has various natural-economic zones, and the system of a farm managment for each of these peculiar zones must, of course, be different.

In the zone of south-east and of the land along the Volga, for instance, the most essential condition, which determines the level of the yield of the main crop here - spring wheat, as it is known, is their provision with moisture. That is why the efforts of scientific workers must be directed to the utilization of the already known, and to the development of new methods for the accumulation of moisture in the soil.

Observations of many years show that the run-off of melted waters in these regions ranges from 100 to 600 cub. m. for a hectare, and some years it increases 2-3 times. On the territory of the 20 arid oblasts of RSFSR and of Kazakhstan only, comprising an overall area of over 200 mln hectares, the volume of waters of local run-offs reaches 35-40 billions of cubic meters. They carry off annually a huge amount of moisture, wash off the fertile layer of soil, decrease the effectiveness of fertilizers and at the same time cause the erosion of the soil with all its aftereffects.

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The experience of leading kolkhozes and of sovkhozes on the lands along the Volga and in Kazakhstan testifies that the use of the simplest and well known methods permits to additionally harvest 1.5-2.5 c [centner = 100 kg = 220.46 lbs] of grain.

For instance, the experience of kolkhozes, in the zone of Dergachevskaia MTS [Machine and tractor station], shows that plowing across the slope with plows without mould-boards in 1955, an unfavorable year, increased the stores of water in the soil by 340 cub. m per hectare and raised the yields by 1.7 c of grain compared to the regular plowing across the slope.

Still the amount of these works on utilization of waters of the local run-offs, which do not require any outlay of capital, clearly is insufficient.

Retention of snow, retention of thawed waters and a wide development of estuary irrigation in arid regions of south-east must be regarded as the foremost national economic problem.

Of great importance in this zone are also the timeliness and the conciseness of the time of sowing. The arid climate of the south-east predetermines the possibility of the loss of the crop through shattering of grains. That is why here the harvesting should be done in as short a time as possible, by utilizing widely separate harvesting for grain crops and an intensive utilization of a fleet of combines.

Different conditions for farming shape themselves in regions of the non-Chernozem belt. Here the precipitations are more or less sufficient, but the soils are poor in organic matter, are structureless and often are highly acid. For this reason the problem is to widely utilize the organic and mineral fertilizers in these regions, as a chief condition for obtaining high and stable yields of all agricultural crops.

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Here are found the richest deposits of peats, much of limestone and tufa. These natural resources, when utilized together with manure, open up really unlimited possibilities for field fertilizing.

But, notwithstanding that it is well known in science and practice how to utilize local fertilizers, how to organize peat-manure farming, these methods are not yet used on a wide enough scale.

For regions of the non-Chernozem belt the use of organic - mineral compounds, of green manure, of phosphorite meal in its pure state, as well as in composts are of great importance; also the introduction of granulated superphosphate into the rows during planting.

It is necessary to widen the use of potassium fertilizers, the resources of which are almost unlimited with us. Also deserving extensive [Begin p.5] use are the bacterial fertilizers and the microfertilizers.

Workers of the chemical industry must also exert every effort for the raising of the quality of fertilizers which are put out, for the expansion of their assortment and a much faster transfer to producing fertilizers in the form of highly concentrated products, such as, double superphosphate precipitate, ammophos, nitrophoska, and many other, which contain two - three times more of nutritive elements, than the ordinary fertilizers.

Transfer to the production of highly concentrated fertilizers will reduce the cost of railroad transportation of fertilizers by half also the expenditure of labor for the loading - unloading jobs; the price of introduction of fertilizers into the soil, as well as the expenses for transportation from the base to the kolkhozes and sovkhozes.

Liquid nitric fertilizers must receive a wide distribution in the next few years, because they are cheaper in cost than the standard nnitric fertilizers. Thus, one of the urgent problems for the scientific institutions in the non-Chernozem zone, along with the others, is the develop-

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ment of a system of measures for field fertilization.

In the non-Chernozem zone are found vast natural forage lands - meadows, pastures. But their productiveness is intolerably low, and this hampers the development of dairy animal husbandry in this zone. Hence, one of the most important levers for a further rise in farming in the non-Chernozem belt is the scientific development and the introduction into production of a system of measures directed to raising the productiveness of meadows, to the creation of cultivated perennial pastures, to a wide distribution of clover plantings, as an important condition for the strengthening of the fodder base, to an increase of the fertility of the soil and a development of flax cultivation as one of the basic branches of this zone's economy.

The characteristic property of the non-Chernozem zone of USSR are its large areas of bottom lands, which is a favorable condition for the development of commercial sheep raising. Production of vegetables and potatoes is especially important here because of the presence of a large number of cities and of large-scale industrial centers.

Vegetable cultivation in covered ground must be developed on a large scale around these centers. One of the tight places in this business is the lack of fuel. But at the same time many of the industrial enterprises have huge heat wastes in the form of hot water, steam and hot air. By utilizing these, it is possible to sharply widen the production of vegetables in winter and spring. The Moskovskii Petroleum Refinery can serve as an example for the organization of hothouse economy utilizing the heat wastes. In 1953 three hothouses, each of an area of 1,000 sq. m., were constructed here and this made it possible to supply with vegetables all year round the kindergarten, day nursery, the mess-room and dispensary of the factory.

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Unfortunately, this nice beginning did not become wide spread. The scientific institutions, which did not study this interesting experiment and did not try to introduce it into the industry, are much to blame.

The zonal peculiarities for the conducting of farming stand out especially clearly in the republics of Central Asia. Of first importance in the cultivation of cotton is the development of problems which are connected with the introduction of the check-hill method of planting with narrowed interrows. The mass industrial experiment by Tadzhik SSR has shown, that this method of cotton cultivation lowers, by approximately 35-40% the outlay of labor expended for the interrow cultivation of plantings and for the control of weeds.

One should say, that our scientific institutions have done very little for the economic interpretation of this method, which was born of practice, even after it showed itself from the best side.

In connection with a considerable thickening of plantings in the narrowed interrows, as well as the need for a speed up in ripening, many problems in cotton agrotechnics require a revision and first of all the method of irrigation, the time, the norms and methods for irrigation, also dates for fertilizer applications.

The scientific-research institutions on cotton until lately recommended that the basic doses - up to 70 percent of phosphoric fertilizers, be introduced in the fall, under the basic plowing, to the depth of 28-30 and more centimeters, and only 30 per cent used in the form of top dressings.

Individual kolkhozes and even whole raions of Tadzhik SSR rejected the autumn application of phosphoric fertilizers and began to use phosphorus entirely as top dressing. The truth here is in favor of the practice.

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Defoliation produces a big influence on the hastening of ripening; it also increases the productiveness of the cotton harvesting machines as well as improves the quality of fibers. Nevertheless defoliation is being adapted very poorly, tThe basic defoliant - calcium cyanamide - is not entirely suitable for our arid raions. Best results are obtained from magnesium chlorate, the production of which is not yet organized on such a large scale that one could start any wide industrial experiments. Here one has a perfect ground for expressing a grievance to the workers of chemical science and to the chemical industry.

In connection with the widening of irrigated lands in the republics of Central Asia, during the current Five-Year Plan, attention must be given to the problems of irrigation, to the regulations in the use of the waters, to the selection of economically profitable crops.

Alfalfa, for instance, is irreplaceable in the cotton crop rotation for obtaining a high cotton yield. High yields of alfalfa in its turn positively influence the fertility of the soil and the production of fodders with a high content of protein.

Together with such a vigorous source for carbohydrate fodders, as corn is (and its areas in Central Asia must be considerably widened) this will provide a stable fodder base for an extensive development of animal husbandry in these regions.

From the above cited instances it is seen how much different are the conditions in various zones of our country and how vitally important it is now, resting on the experience accumulated in science and in practice and their data to develop a zonal system of farming.

It seems to us that a system for farm management, which is worked out by the zonal institutes with the help of workers from higher institutes of

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learning, from experiment stations, and from leaders and specialists of the industry must be discussed at agricultural conventions. It must become a guide for kolkhozes, MTS's and [Begin p.6] sovkhozes, which then will introduce some more precise details which are applicable to their own conditions.

When working out a system for farming according to separate natural-economic zones, one must take into consideration also certain general problems, besides those that are specific to each one of the zones.

In the field of animal husbandry such general problems will be connected with the building up of a stable fodder base, although this question has to be solved differently for each zone.

Increases in corn plantings will help to sharply raise the production of fodder in all the regions of the country; but for a full-value feeding of animals and poultry , together with the widening of corn plantings and of the heightening of their yields, enlargement in the production of protein fodders, in the form of legume plantings, which will vary in their assortment according to zones, acquires a very important meaning.

It is very important to expand the production of combined fodders for animal husbandry, enriched with proteins and vitamins, as well as to utilize partial protein substitutes such as, for example, urea, antibiotics and mineral fodders.

Improvements in breeding work require very serious consideration. It is necessary to say, that we do not pay much attention to the studies and utilization of the phenomenon of heterosis in animal husbandry. Meanwhile every thing indicates that here exists a huge reserve for an increase in the productiveness of the animals. Cross-breeds adapt themselves better to the conditions of life and give more production per unit of fodder, than purebred animals.

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It is urgently needed to start selections of breeds for industrial cross-breeding in dairy animal husbandry.

Scarcity of highclass pedigreed producers of the necessary breeds cannot limit us in this business as there is a method of artificial insemination, which permits to service 1-2 thousand cows by each pedigreed bull.

By introducing artificial insemination everywhere it is possible to quickly overcome the usual shortage of good pedigreed producers.

If the artificial insemination in sheep breeding is conducted satisfactorily in our country, in large cattle breeding it is most unsatisfactory.

Dairy farms with pedigreed cattle, by utilizing artificial insemination, could service millions of cows in kolkhoz herds by the best bulls in the country. This method is especially promising in the problem for the increase of fat content in milk of some breeds.

The advantages in cross-breed animals make the work of breeding purebred cattle very important. Yet both pure breeding of animals and supplying with purebred material are organized badly. And without a well organized breeding work one cannot organize an inter-breed crossing on commercial animal husbandry farms widely and properly.

Organization of inter-breed crossing in poultry breeding can increase sharply its productiveness. As experience indicates, meat production is increased by 25%, and egg-laying by 6-10%.

Inter-breed crosses in swine wuse 12-16% less fodder for the production of meat than do the purebred ones. Virtually the problem of selection in different regions is to find two or three breeds of swine for cross-breeding.

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The problems of veterinary science are great. Losses in animal husbandry from animal diseases are still very considerable. Our veterinary science must concentrate its efforts for finding new, effective and cheap means and methods for prophylaxis and treatment of animal diseases. In domestic and foreign practice the use of antibiotics has proved itself as an effective means for the control of various animal diseases, as a stimulator for the increase in weight of young animals and birds. These problems requiresmore attention.

In the struggle for a sharp ascent in agriculture the strengthening of the material-technical base - the equipping of MTS, of sovkhozes and kolkhozes with the newest technical equipment and its correct utilization is of decisive importance.

The urgent problem of the scientific institutions is a development of a system of machines for a complex mechanization of farming taking into consideration the conditions existing in different zones of the country. It is necessary to improve the work of planning and construction of new agricultural technical equipment.

We have serious defects in this work. For instance the seedling planting machine does not guarantee the required quality of work, is unreliable in operation. It is economically ineffective - tit does not decrease the outlay of labor for vegetable planting. Unfortunately, data about the construction and production deficiencies of the machines are not generalized and are not studied either by the scientific institutions, or by the agricultural agencies. The methods and program for testing the machines need very serious improvements.

Vast works in the field of electrification are being contemplated. During the sixth Five-Year -Plan a number of electrified kolkhozes will be

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doubled, the electrification of sovkhozes and of machine-tractor stations will be finished.

The basic source for the electric supply of kolkhozes and sovkhozes will be their connection to the networks of large government electrostations and power systems. In connection with this, in the next five years, hundreds of thousands of kilometers of rural electric lines of high and low voltage must be constructed. Science must work out the most economical methods for transmission and distribution of electric power on the farms.

One should continue and amplify the work of the All-Union Scientific Research Institute for Rural Electrification; they suggested electric transmission lines utilizing the earth as one of the leads, which will save 30% in leads and isolators, and lower by 20-25% the cost of construction of rural electric lines.

A fair criticism of the economists - agriculturists by the 20th Convention of the Party will serve as a serious impetus for a basic improvement of scientific work in the field of economics and of organization of agricultural production.

The efforts of economists must concentrate on the solving of questions for the raising of labour's productive capacity and the earning capacity of the industry; on the planning and specialization of agriculture; on efficient distribution of branches of agriculture and their correct combination in various natural and economic regions of the country; [Begin p.7] on how to increase the effectiveness of utilization of lands, machines, technical equipment and labour resources; on improvement of the organization, standardization and remuneration of labor in kolkhozes, MTS and sovkhozes; on strengthening of the material interests of the workers of kolkhozes, MTS, and sovkhozes in the increase of the yielding capacity of agricultural

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crops and the productiveness in animal husbandry, in order to receive the greatest amount possible of production from each unit of area; on the increase in the earning capacity of basic branches in farming and animal husbandry; on the economic effectiveness of agricultural and zootechnical measures.

The direction of TsK of the KPSS to turn the attention of our cadres to the problems of economics will be successfully accomplished, when the whole army of our scientific workers will be included together with the economists into the solving of these questions.

The resolution of TsK of KPSS of our Party and Government "About the measures on the improvement of work of the All-Union Academy of Agricultural Science imeni V. I. Lenin" gives us a clear program on the rearrangement of the Academy's activity and of the whole system of agricultural scientific research institutions.

Carrying out this decision, the Academy will take all the measures in order to end serious deficiencies which are hampering further development of agricultural science, will strengthen the bonds of scientific institutions with industry, direct the energy of scientists to the solving of actual problems, to raise the part and the responsibility of scientific workers in the guidance of farming.

The urgent problem of the Academy is the elevation of the theoretical level of the scientific work, a fuller utilization of methods and achievements of allied sciences and of attainments of scientific institutions in foreign countries. Measures are being taken to draw the institutes and the experimental stations nearer to the industry, on creation for them of experimental bases and taking the scientific institutions out of the cities to work under actual conditions of production.

The Academy proposes to practice widely creative discussions about the

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most important problems, utilizing the tested, and vitally important under our conditions, method of criticism and of self-criticism, which is directed to the elevation of the quality of our scientific inve investigations and scientific production, to deeper study our rich practice, to timely generalize and introduce into production new progressive procedures and methods, to arm our planning and farm agencies with new data and materials on the development of agriculture.

A materialistic direction in the agricultural and biological sciences is and will be, the basis of the Academy's work. The Marxist-Leninist doctrine will continue to be in the future the guiding star for the multiple army of scientific workers.

The sixth Five-Year-Plan will enter into the history of our native country, as the Five-Year-Plan of a further powerful development of the forces of production, of a continuous technical progress.

Wide horizons are opening for our forward movement, for the growing tempos in the development of agriculture, for a sharp rise in agricultural production, for a considerable improvement in the well-being of the Soviet people.

The scientific workers will bend all their energies, knowledge and abilities in order to win the historical battle in the economic competition - to overtake and surpass the most developed capitalistic countries in the products of industry per head of the population and thus worthily to repay the great care of the party and the government for the development of agricultural science.

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Fratkin, A. and Mushnikova, K.

Bor'ba s vrediteliami i bolezniami kukuruzy.

[Control of pests and diseases of corn].

Kolkhoz. Proizvodstvo vol. 15, no. 4, p.24,
April, 1955. 281.8 K83

(In Russian)

Corn, in all the regions of its cultivation can be infected by two kinds of smut: Boil smut [Ustilago maydis] and head smut [Sorosporium Reilianum]. When the spores, which cause the boil [common] smut hit a young, growing part of corn, they germinate, enter into the tissue, and form a mycelium there. A boil (a nodule), which is covered with a grayish film appears after 14-20 days on the surface of the infected place. On the stems these boils usually are spherical; on the leaves they settle along the ribs and are elongated. In the corn cobs the boil smut infects either one or several ovaries at one time, in the panicle - separate flowers. Soon after the formation of the boils the mycelium breaks up into lobules and produces the spores. When the spores ripen, the coating on the boils breaks, and the spores are scattered by the wind. On entering the soil they germinate and form a great number of small spores (basidiospores), which are also spread by the wind; they hit the plants and infect them. The spores overwinter in the soil and on the remnants of the harvest.

Boil smut destroys the seeds in the cobs, as well as the assimilating apparatus of the plants. Besides this, a great loss of moisture occurs when the coating on the boils bursts. All this depresses the

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plant and results in considerable losses of the harvest.

The other disease - head smut, leads to a complete loss of the crop. It infects both the cobs and the panicles of corn turning them into a dark powdery mass of spores. The infected cob is always covered by the husks. The corn plants are infected by head smut during the germination of seeds and the sprouting period. Title of figure in the first column: a corn cob infected by boil smut.

It is necessary to treat the seeds with poison chemicals in order to control both boil smut and head smut. For a dry disinfection preparation granosan (NIUIF-2) is used in a dose of 100 grams per one centner [c = 100 kg = 220.46 lbs] of corn seeds, or the preparation AB in a dose of 150-200g per c. Disinfection is conducted with the aid of PU-1 or AB-2 machines, PSP-0.5 apparatus or in specially equipped barrels.

Title of the upper figure in the second column: corn stalk infected by caterpillars of the European corn borer.

Title of the lower figure in the second column: corn seed damaged by the wireworm..

In order to obtain healthy seeds of corn a selection of healthy seed corn cobs right in the field on the plants before harvesting, or before putting them into storage is of great importance, as also repeated selection of seed corn cobs before threshing.

In order to destroy the source of infection of corn by boil smut, as well as to decrease the depressing action of this disease on the plant, it is recommended to gather and destroy the smut boils in the field. The smut boils must be cut off and destroyed, without fail, by means of burning or burying them to the depth of not less than 50 cm. The boils must

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be gathered 2-3 times during the summer, without letting them ripen and spread the spores.

Among the pests of agricultural crops the most damage to corn is done by the wireworms and the caterpillars of the European corn borer. The larvae of click beetles (Elateridae) damage corn in all the zones of its cultivation.

The greatest damage is done by the wireworms during the spring when they move from deeper into the upper layers of soil where they damage the planted seeds and the sprouts of corn.

Both agrotechnical and chemical measures are used for the control of larvae. Among the agrotechnical measures of great importance are: a deep autumn ploughing with plows that are equipped with a colter, a careful preplanting tillage of soil, and a timely cultivation of plantings. Introduction into the soil of hexachloran is a reliable chemical method for the control of wireworms. A local and a continuous application of hexachloran is used. In the first case a 12% dust of hexachloran is used and in the second - 25% hexachloran mixed with phosphorite meal.

During a local application the corn seeds are powdered with hexachloran before planting. Dusting the seeds is done either in seed-treatment machines or in specially equipped barrels after they have received a dry treatment with the preparation AB or granosan. The norm of outlay of hexachloran is 1-2 kg per one centner of seeds. In regions with insufficient spring moisture in the soil the norm of outlay of hexachloran must be decreased to 300g per centner of seed. The dusted seeds should not be returned into storage but planted immediately.

Title of figure in the third column: corn sprouts damaged by wireworms.

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A continuous introduction of hexachloran into the soil is conducted on sections which are heavily infested by the wireworms. For this purpose the 25% hexachloran, mixed with phosphorite meal, is introduced under cultivation to a depth of 10-12 cm. The preparation is evenly distributed over the wireworm infested field and immediately turned under by the cultivator because under the action of sunlight the toxicity of hexachloran is weakened.

On light, sandy or sandy loam soils the 25% hexachloran is introduced in the amount of 40 kg per ha, and on heavy clayey soils of 50 kg.

Potatoes and other rootcrops should not be planted in the course of three years on fields treated with the 25% dust of hexachloran.

The caterpillar of European corn borer is an equally dangerous pest of corn. This caterpillar is of a light yellow color with a reddish tint, up to 25 mm long. It overwinters on corn stalks, on millet, hemp, sorghum, sunflowers, and other agricultural crops, as well as on the stems of broad-stemmed weeds - mugwort, amaranth, and others. In the spring, usually at the end of May or the beginning of June, caterpillars take the form of a chrysalis. The butterflies which flow out from the cocoons lay eggs on the under side of corn leaves and of other cultivated and weed plants.

The caterpillars make a passage in the corn stalks, and in the pedicle of the cobs and damage the seeds. These damages often produce partial breaks in stems and corn cobs, and also assist in the infection of the grain with various diseases, especially Fusarium. At the end of the vegetative period the caterpillars crawl over into the lower part of the stalks of the damaged agricultural and weed plants and overwinter there.

The basic method for control of the European corn borer is the destruction of the caterpillars which overwinter in the stalks of corn and

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other plants. For this purpose it is first of all necessary to cut the crops as low as possible during harvesting. Thus, during harvesting corn, its stalks must be cut at a height of 10-12 cm from the ground and removed from the field. For raking the stalks one can utilize horse-rakes or heavy harrows. Besides this, on fields which arei infested by the European corn borer, it is especially necessary to conduct deep autumn plowing with colter plows. The gathered stalks of corn and of other plants, where the caterpillars of the European corn borer overwinter, can be utilized for silage and for heating during winter, but not for calking to make the buildings habitable in winter or for making fences.

An important measure in the control of the European corn borer during the spring (up to the beginning of May) is the gathering and burning of corn stalks and of other broad-stemmed plants, which were left for the retention of snow.

Title of the figure on the bottom of the fourth column: a corn cob damaged by the caterpillars of the European corn borer. during the sp

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Marland, A. Kh.

O prognose poiavleniia fitoftory kartofelia (Phytophthora infestans de Bary).

[Forecasting the appearance of potato Phytophthora (Phytophthora infestans de Bary)].

Akad. Nauk Estonskoi SSR, Izv., vol. 4, no. 1, p.113-115. 1955. 511 Ak19

(In Russian)

Summary

A welltimed conducting of measures for the control of plant diseases is one of the means to guarantee high yields of agricultural crops. Appearance of Phytophthora infestans [late blight] on potatoes has been held by the researchers long ago to be dependant on the specific conditions of the weather. The first attempt to forecast the appearance of late blight of potato was made by van Everdingen (4), who established the so-called "Dutch signs", which included the following conditions: in the course of 15 days, which precede the appearance of late blight there should be a day when: 1) during the night fog keeps up not less than four hours at a time; 2) when minimum temperature at night is not lower than $+10°$; 3) when next day, after this night the average cloudiness is 0.8 or higher; 4) when next day falls not less than 0.1 mm. of rain. In this form, without any critical evaluation the cited "signs" entered the phytopathological practice and are recommended in many contemporary textbooks, sometimes with insignificant changes.

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N. A. Naumova (15) worked at checking these "signs" under conditions of USSR and came to the conclusion, that the "signs" need to be made more precise and further investigated. She thought that according to the "signs" one can establish approximately the day of primary infection, but for determining the time of the appearance of infection it is necessary to know the length of the incubation period, which depends on the temperature. She worked out a specific nomographic chart for the calculation of the incubation period, as well as an instruction on signaling the time for spraying potatoes for the control of late blight (14).

We checked the possibility of utilizing "Dutch signs" and the cited instruction under conditions of Estonian SSR. Experiments were conducted in 1948 and 1949 near the city Tartu, at the Educational-Experimental Farm of the Tartu Government University*, with three varieties of potatoes - Fruibote, Ostbote and Iygevask yellow. Observations of the appearance of late blight were conducted on the basis of meteorological data, obtained from Tartu meteorological station.

We have ascertained, that the appearance of late blight of potato during these years proceeded without any connections to the "Dutch signs". We also utilized J. Aamisepp's (1) data of observations of the appearance of late blight of potato, which he conducted with a large number of potato varieties in Iygeva during the period between 1928-1935. It was found out that late blight for the most part appeared independently of the cited signs.

* At the present time it is the Educational-Experimental Farm of the Estonian Agricultural Academy.

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Certain authors (9,10) think that late blight is exclusively a result of plentiful rains during July and August. But it was found that such a relation does not exist always. One must also take into consideration other accompanying factors; for instance, influence of rains on different varieties of potatoes ofunder different soil conditions. The amount of rain, which is normal for one and the same variety of potatoes on sandy loam, can be harmful on clayey soil. Unfavorable [Begin p.116] circumstances of the environment condition the violation of physiological processes in the plant and thus create conditions for susceptibility to disease. This is pointed out by A. I. Borggardt (5), A. I. Grechushnikov (7), A. I. Grechushnikov and Z. S. Klimova (8), M. V. Gorlenko (6), and others.

E. van Everdingen, in his work, did not take sufficiently into account the existence of interconnection and interdependence of processes, which take place in nature, as well as the role of influence of man on these processes. He assumed that there existed a break in time between the appearance of the first symptoms of disease on potato shoots and the final appearance of the disease at the end of summer, and thought that the disease appeared suddenly, according to his index. But this assumption is incorrect at its root, because the infection of the late blight on potato in the field develops with certain intervals depending on the ecological conditions. The mass appearance and development of infection is timed to the moment of joining of tops, that is to that time, when best ecological conditions for the fungus are created. Density of the tops, contamination of the field and other factors, which take part in the creation of the microclimate that helps the development of late blight on potatoes or, on the contrary, inhibits its development, have a strong influence on the appearance and development of the late blight. The agricultural background is of special importance as a means for increasing the resistance of

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potatoes to late blight, as it is pointed out by Academician I. G. Eikhfel'd (18). This assumption was corroborated by experiments conducted at Iygevask Government Selection Station, for instance, with the variety of potato Dr. Aamisepp. Resistance to late blight can be increased also by means of utilization of various microelements (11,16).

It follows clearly from the above said that forecasting the appearance of late blight on potato only on the basis of "Dutch signs" is ineffective under our conditions.

A basic condition for the control of late fblight is the accomplishment of all agrotechnical measures which will improve the sanitary conditions of potato seed material. It is necessary to select healthy tubers for planting and to spray potatoes before the joining of the tops with 1% solution of Bordeaux mixture; spraying should be done three times at an interval of 8 days. Accomplishment of the cited measures will hi help in a considerable lowering of losses from the late blight of potato.

Estonian Agricultural Academy

Entered the editorial office Dec. 4, 1954.

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Problema "zarazheniia" pochv i sel'skokhoziastvennykh posevov produktami radioactivnogo raspada. (Obzor glavneishikh literaturnykh dannykh).

[The problem of "contamination" of soils and crops with the products of radioactive fission. (A survey of the principal literary data)].

Pochvovedenie, no. 8, p.57-73. Aug. 1956. 57.8 P34

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The problem of "contamination" of soils and of agricultural crops with the products of radioactive fission arose for the first time after the testing (and use) of the atomic and hydrogen bombs. Until that time there were very few cases of such contamination, and, even if they occured, nothing was reported about them in the press on account of secrecy. As the bomb tests will be repeated, the spreading of products of nuclear explosions over a considerable area of the earth's surface (at least in the regions of bomb tests) cannot be avoided. Besides this, such cases are possible when a large territory becomes contaminated on account of a serious breakdown of a reactor. All these factors, not speaking about atomic warfare itself, should, of course, produce a substantial influence on the course of the biotic cycle including plants, soil and animals. That is why, those unfortunately few literary sources which give factual data about the composition, and the physico-chemical properties of the basic products of fission, and of the mechanism of their reaction on the surrounding area, are, undoubtedly, of great interest.

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These data, besides their scientific importance are also of practical interest. They can be useful when means for protection are being developed.

Composition and some of the properties of the products of nuclear fission.

A considerable number of observations and of researches were conducted to study the composition and the properties of products of nuclear fission. The most diverse materials have been studied: radioactive ashes, cultivated and wild plants, natural and artificial water reservoirs, soils, certain plant and animal organisms, as well as other objects, which were present in the zone of radioactive contamination.

During the process of these researches the products of nuclear fission were classified in a different manner. The simplest classification scheme is cited here, which was offered by Amphlett (7) and by Mitikhiko (4).

Products of nuclear fission are sub-divided by these authors into two groups: ionic and non-ionic. The chief mass of products of nuclear fission consists of insoluble compounds composed of radioactive substances, in addition to: alloyed ferric oxides (bomb material), certain silicates (in case of explosion on the earth's surface), undecomposed products, which were initially within the bomb (plutonium, uranium) and other components. One to 10% of activity is in the ionic form. Cesium, strontium and iodine are the main carriers of this activity. It is characteristic that part of the elments is fused into [Begin p.58] the particles which are composed of metallic oxides. The other part solidifies irreversibly on clays and soils[1].

Footnote [1]. It is well known that at temperatures which exceed 1,000° C, montmorillonite, soils, and other adsorbents, which have a high volume of absorption, can irreversibly absorb not only alkali earth, but also the alkali metals.

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The latter groups will refer to non-ionic (insoluble) forms.

The authors refer the colloidal forms of the products of fission also to the non-ionic forms(2). The colloidal state of radioactive substances causes the ease with which they adhere (become adsorbed) to the surface of plants (and of other objects). This same property plays an essential role in the process of removal of the sources of radioactive contamination, which will be spoken of later.

The composition of the products of nuclear fission is determined by various methods. In the most typical cases, for instance, in the experiments of Japanese researchers: Egawa (10), T. Mitikhiko (4), and others, the following methods were utilized. Samples of agricultural plants after a preparation and separation into roots, stalks, leaves, and grains (or fruits) were heated in an oven up to 60° C and then were ground to the necessary size.

Separate portions of each sample were put on platinum combustion boats, weighed and burned in a muffle furnace at a temperature of 500-600° C.

Part of the ashes (1g) was utilized for determination of the total (summary) activity. Another part (50g) - for isotopic analysis. Measurements have shown that general activity of the samples, which was determined by "tortsovyi" "counting tube" [Geiger counter] was found to be correspondingly equal (for 1g of ashes): clover 105, sorrel - 72 and lotus 66 imp/m(3).

Footnote (2): In literature there is no unanimous opinion on the problem of radio-colloids. One group of researchers (Hahn, Werner, and others) thinks that the formation of radio-colloids is coupled with phenomena of adsorption of ions of radioactive elements on the surface of the extraneous particles (dust particles) which are suspended in solutions. The other group (Panet and others) thinks that the phenomena of adsorption play a secondary role and that often radio-colloids consist of the particles themselves of the radioactive substances. The works of Soviet researchers (I. E. Starik, B. A. Nikitin, and others) as well as the facts of the present time convince one of a greater truth of the second point of view (for more details see S. E. Bresler, 1952).

See Footnote (3) on the beginning of next page.

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Footnote (3). It is spoken here about testing of those plants, which were conducted in the spring of 1953 in the southern regions of Japan after the falling of radioactive rains dand ashes (the falling of these rains occured after tests of atomic and hydrogen bombs, which were conducted in the region of Bikini.

The isotopic analysis was conducted in the following manner (method of T. Mitikhiko). A weighed portion of ashes (50g) was placed into a procelain cup and was treated with concentrated hydrochloric acid. The author, conditionally, refers to the first fraction those substances which did not dissolve after several treatments with concentrated hydrochloric acid. Since into this group enters an acid-resisting group of compounds, the author thinks that the basic components of this fraction are zirconium (Zr) and its daughter isotope niobium (Nb).

Other elements besides zirconium and niobium, were found in the first fraction: Ba^{140}, Sr^{89}, and an insignificant amount of Sr^{90}. The author supposes that Ba^{140}, Sr^{89} and Sr^{90} became converted into sulfates during the process of burning the plants, and as much as the sulfates of these elements do not dissolve in HCl, it was natural to assume that in the residue, besides Nb and Zr, were also contained $Ba^{140}SO_4$, $Sr^{89}SO_4$, and $Sr^{90}SO_4$. During a repeated treatment of this sediment by hydrofluoric and hot sulfuric acids and after performing other simple operations, about which we are not going to speak here, this supposition was fully confirmed.

The author refers to fraction II those substances which were obtained as a result of treating the ashes by a solution of 0.3n hydrochloric acid and passing of H_2S. The author supposes that into this fraction enter mainly [Begin p.69] ruthenium (Ru), rhodium (Rh) and tellurium (Te).

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Besides this, the author considers probable in the fraction II the presence of selenium (Se), molybdenum (Mo), silver (Ag), cadmium (Cd), and of antimony (Sb)(4).

The next fraction, called by the author III^{a}, was obtained from the filtrate of fraction II. Products of nuclear fission, which enter into this fraction, are mainly rare-earth elements and zirconium in a small amount. Phosphates of alkali earths also entered in a certain amount into the fraction III^{a} (during that method of isolation of rare-earths which the author used). The phosphates of alkali earths can be fully isolated from rare-earths. For this purpose the phosphates are converted into carbonates, then they are dissolved in hydrochloric acid and by means of addition of NH_4OH they are converted into a precipitate. Proceeding in just this manner, the author established, that there is only an insignificant amount of phosphates and that the radioactive elements in the fraction III^{a} are almost fully represented by the elements of rare-earths.

To the filtrate, after removal from it of fraction III^{b}, the author added $(NH_4)S$. A small precipitation of sulfur compounds was filtered out and examined by utilizing the usual methods of radio-chemical analysis. It proved to be that the greatest part of the precipitation was ZnS. This precipitate the author later on named III^{b}. Radioactivity of fraction III^{b} proved to be very low, and one can suppose that it is produced by the presence of those same rare-earth elements which were refered by the author to fraction III^{a}. Yet, on the basis of later experiments, in the process of which a repeated precipitation of rare-earth elements was utilized (to

Footnote (4). Other authors (1) who made tests of radioactive ashes, gathered from the ship "Fukuriu-Maru" did not corroborate this supposition (that is a supposition about the presence of selenium, molybdenum, and others).

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evade a contamination with them of the ZnS precipitate), as well as on the basis of observations of other authors, who were, in particular, occupied with studies of contamination of fish with products of radioactive fission, the author concluded that one can still admit the presence of Zn^{65} in the precipitate, which was formed from Zn^{64} $(n, \gamma)^{(5)}$.

A solution $(NH_4)_2CO_3$ was added to the filtrate, after the extraction of the precipitate of fraction III^b. Fraction IV was obtained after boiling; it separated in the form of a precipitate of carbonates. Judging from the radio-chemical analysis, basic radioactive isotopes of this fraction are Ba^{140}, Sr^{89} and Sr^{90}. The amount of radioactive calcium^{45}, which is a product of fission of Ca^{44} (n, γ), was quite small.

Radioactive iodine I^{131}, I^{132} remained after isolation of fraction IV in the filtrate. During the process of preparation of the materials for the analysis (ashing the plants), iodine, apparently, evaporates partially. Thus, the given method of examination of radioactivity of iodine, in the opinion of the author, gives low results.

Similar researches were conducted by Egawa (10). His data, obtained when studying ashes of contaminated plants (burdock, beets and tea) gave practically the same results which we considered just now. Radio-chemical examinations of ashes, which fell out on the ship "Fukuriu-Maru", are of great interest for a correct solving of the question about the nature and properties of these elements, which cause radioactive contamination of soils and plants. These researches were made to find means for a medical treatment of the ship's company, who suffered from the reaction of products of

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Footnote (5). The last term denotes a type, of nuclear reaction. It shows that, in the case under consideration, the reaction proceeds without isolating any other particles besides γ-rays.

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nuclear fission. These examinations have shown that the ratio of isotopes, discovered in the ashes, is about the same as in the plants which were examined by the authors cited previously. Thus, several methods, independent of each other, [Begin p.60] which determined the nature and properties of radioactive elements, and which were performed by different persons, gave coinciding results about the fact, that the main carriers of radioactivity are those elements, which were conditionaly subdivided into five examined classified groups. Simultaneously with the isotopic analysis, the total activity (for each fraction and for each plant) was also determined.

Data, relating to this, together with the results of the radiochemical analysis is cited in table 1.

Table 1.

Composition of products of nuclear fission and radioactivity of separate fractions (per 50g), isolated from radioactive ashes in counts/m (According to data of Mitikhiko, Isikhora, Egawa and others).

No. of the fraction	Clover	Sorrel	Lotus	Radioactive elments
I	112	203	160	Nb, Zr
II	111	251	101	Ru, Rh, Te
III^a	4690	2365	2634	Zr, rare-earth elements
III^b	19	59	19	Zn^{65}
IV	204	188	173	Ba, Sr
V	403	199	334	J
	5539	3225	3441	

Table 1 shows that the level of activity of all plants depends, chiefly, on the presence in them of rare-earth elements. If one analyzes the spreading of activity, taking clover as an example, (second column of the table) then it is easy to see that the first fraction is 2%, the second 2%, while for the III^a fraction it is 84.7%. About the same picture is seen for other crops also.

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Absorption and movement of radioactive elements in plants

At the present time, when leaf feeding of plants is practiced, one can hardly doubt that at least a part of radioactive elements, which hit the surface of the plants, enters through this surface and is absorbed by the plants. The energy of this absorption and the apportionment of the radioactive elements in the individual organs of the plants was studied with several plants. Utilizing radioactive dust, Mitsui and others, examined the reaction of radioactive elements on tomatoes and on pumpkins. For the experiments with tomatoes young plants, having six-seven leaves, were utilized. The young plants were placed into vessels with the nutritive medium and on every 4th or 5th leaf radioactive dust was applied, having been previously moistened with water (for a better adherence of the dust to the surface of the leaves). Initial activity of dust was equal to 2098 counts/m per 1g. After a definite time (after 490 hours) samples of leaves were taken for analysis. It proved to be that about 13-16% of radioactivity was transferred into those parts of the plant, which were not subject to direct contamination. In the experiments with pumpkins another method of observations was used. A water, a hydrochloric acid and a citric acid solution ses were made from radioactive ashes. A certain amount of each solution was applied to the third leaf of the plant, and, after 6 and 15 days, a determination of the amount of radioactive substances, which were transferred from the spot of their initial location [Begin p.61] to other points on the plant where specimens were taken for analysis. As a result of experiments it was established: when utilising a water solution after 6 days 7% of radioactivity was transferred to other places

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from the contaminated areas, and after 15 days - 15.4% of radioactivity; when utilizing citric acid solution it was, correspondingly, 18.7 and 13.2% of radioactivity; when utilizing hydrochloric acid solution the absorptive capacity proved to be very low, which can be explained, in the opinion of the author, by reaction of formation of NaCl. The cited data show that radioactive substances, falling out in the form of dust or together with the rain, are absorbed quite rapidly by the surface of the plants' leaves. The coefficient of this absorption varies in fairly wide limits. Roughly speaking, it can be assumed to be equal to about 10% of the total amount of radioactivity, which has settled on the surface of the plants. Yet, a question arises: do all the radioactive elements possess a similar energy for absorption? Are there not among them such ones which possess a selective absorptive ability? If so, which ones exactly?

Additional observations were conducted to clear up these questions. During the experiments with pumpkins (the scheme of these experiments was examined previously) a certain part of the plant leaves, which have undergone the contamination and some that did not, was examined for the content of radioactive elements. Utilizing the methods of fractionation, which were already familiar to us, (which were considered previously), we isolated five fractions of radioactive elements.

Moreover each fraction was obtained not only from those parts, which were directly contaminated, but also from those that were not thus contaminated (where they were then transmitted as a result of their translocation along the plant tissues). Computations of the activity of these fractions are cited in table 2.

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Table 2.

Energy of absorption of radioactive elements in counts/m (according to data of Mitsui and others)*

Fraction	Contaminated part	Energy of absorption in %	Methods of extraction
Nb, Zr	1367	36	Non-adsorbed part**
Ru, Rh, Te	1529	39	0.5% solution of oxalic acid.
Rare-earth elements	9278	6	5% solution of citric acid, pH 3.5
Ba, Sr, Ca	68	32	Same solution, pH 6.0
–	295	0	4-n solution of hydrochloric acid

* In the primary sources, which we utilized, a degree of authenticity of these data was not ascertained.

** The author names that part of the solution non-adsorbed, which is not adsorbed by cation-exchange resin.

The table shows, that for conditions which are being examined the energy of absorption of Zr, Nb, Ru, Rh, Te, as well as Ba, Sr and Ca is practically expressed by one and the same value, which ranges in the limits of 32-36%. It is hard to say to what extent these data are regular (and authentic). In any case, the conclusions which were made in keeping with these data are sufficiently satisfactory. That part attracts attention [Begin p.62] in the table where the energy of absorption of rare-earth elements is considered. It is characteristic that the activity of this fraction in points of direct contamination of plants exceeds a corresponding activity of other fractions by 5, 20, and even in excess of 30 times. Yet the energy of absorption of these elements proved to be very low (it is about six times lower, than in other elements).

The last line in the table once more confirms the interesting case (which was cited previously), that when the method of hydrochloric acid solution is used to contaminate the plants practically no translocation of

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radioactive lelements is seen in the plants' tissues.

Principally data of Japanese authors were cited above. Corresponding researches of the same aspect were conducted in America. Researches of the Americans had as their goal to establish not only a degree of absorption of the most dangerous radioactive elements by the plants, but also to clarify the influence of the environment (particularly, influence of cultivation and of fertilizers) on the processes of this absorption. Below we cite results of experiments, which were conducted with plutonium, and with some of the products of its fission.

Absorption by the plants of plutonium and of some of the products of its fission (zirconium and niobium).

Plutonium - 239 is one of those elements, which for the first time was made during the process of atomic production. Out of all the radioactive elements it is the most dangerous for man(6). During an atomic explosion part of it dissipates in the same state as it was within the atomic bomb. Exactly this non-fissionable plutonium was the subject of the researches under scrutiny. At first we will pause on the results of experiments by Jacobson and Overstreet (11) which were conducted with various compounds of plutonium. Barley was used as the experimental plant; it was grown in a bentonite suspension containing appropriate compounds of plutonium. The scheme of these experiments and their result are shown in table 5.

Footnote (6). Plutonium is strongly poisonous, and judging from literary data (5) it is lethal in doses of 0.5 mg.

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Table 3.

Uptake by barley of various forms of plutonium (according to data of Jacobson and Overstreet)

Isotopes Pu	Period of half-life	Absorbed by the root system %	Passed into the leaves %
PuO_2^{++}	24.10^3 years	37.8	0.010
Pu^{++++}	24.10^3 years	24.6	0.0024
Pu^{+++}	24.10^3 years	20.3	0.00015

The table shows, that the barley root system absorbs sufficiently large amounts of plutonium. It is characteristic that these amounts are in a reverse relation from its valence. Above ground organs of the plants, especially in those variants of experiments where the trivalent and tetravalent compounds of plutonium absorbed insignificant amounts of this element which were measured in 1,000-th and 10,000-th parts of a per cent.

A similar picture was recorded by Selders (19). He conducted experiments with soils, which were contaminated (as a result of atomic explosion). [Begin p.63] by mixed products of fission, containing, in particular, some forms of plutonium. Beans, barley, tomatoes and Russian thistle were utilized as experimental plants. He reports, that he did not observe any translocation in the plants of the elements, which radiate α-particles. As much as plutonium is an α-radiator, it ensues that plutonium did not enter the aboveground organs of the plants[7].

Footnote[7]. Some of the isotopic varieties of plutonium, for instance: Pu^{239}, Pu^{241} have mixed radiation, that is, besides α-particles they radiate also γ or β-particles. For more detail see "Table of isotopes" by G. Seaborg and I. Perlman, 1951.

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How this phenomenon can be explained - it is hard to say(8). At any rate, one can hardly doubt in its authenticity, because similar facts, as it will be seen from the following account of the material, were noted also during tests of other radioactive isotopes.

Data which were obtained when studies were made of $Zr^{95} \neq Nb^{95}$ are also of great interest. These radioactive elements are products of plutonium fission and have a long period of half-life (Zr^{95} 65 days; Nb^{95} 35 days), consequently their role in the contamination of vegetation and of the soil (at least for a while after the atomic explosion) proves to be quite substantial. It was shown in the experiments of Jacobson and Overstreet (11) that the root system of barley absorbs about 33.3% of that amount of these elements, which was contained in the nutritive substrate. Meanwhile, in the aboveground organs (leaves) only an insignificant amount was found, which was measured in the thousandth parts of a per cent (0.0031). In similar experiments by Vlamis (22) zirconium and niobium were introduced into the soil. Carrot was the experimental plant. Measurements of the activity were conducted eight weeks after the beginning of the experiment. The measurements have shown that the activity of the root system of the carrot was very high, and the activity of other organs - incommensurably smaller. The author thinks that the absorption of these elements by the plants proceeds in two ways: by means of catalytical adsorption and by way of migration of these elements with organic acids, which are isolated by microorganisms. And yet the author does not cite any data based on facts that would confirm these ideas. A Japanese researcher Mitsui (2,3),

Footnote (8). It is not excluded, in particular, that the toxic action of plutonium is deforming the conducting systemoof plants so strongly that a movement of plutonium compounds in a usual manner (through the conducting system) proves to be either very difficult or quite impossible. What regards the phenomenon of migration, linked to the laws of diffusion, this problem, evidently, remains unstudied.

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who conducted experiments with young sprouts of pumpkin, noted, approximately, the same character of distribution of radioactive elements in separate organs of the plants. These sprouts were grown in a nutritive medium, which contained radioactive ashes (Bikini). Radioactivity was measured in all parts of the plants ten days after the sprouts were planted. Data obtained is cited in table 4.

Table 4.

Absorption of radioactive substances from the ashes of Bikini by pumpkin sprouts (according to data of Mitsui, and others).

	Ovary	Upper leaves	Lower leaves	Stem	Roots
Counts per minute	43	157	169	128	3462

The table shows that the bulk of radioactive substances was concentrated in the root system of the plants. In other organs the level of activity proved to be considerably lower (in the leaves and stalks, for instance, almost 20 times, and in the ovary almost 80 times less than in the roots). Experiments by Selders and by others (19) pursued the same goal. They were, conducted according to a very simple scheme. Into the soil, which was contaminated as a result of atomic tests [Begin p.84] by mixed products of fission beans, tomatoes, barley and Russian thistle were planted and sowed. One part of the plants was grown on fertilized soil, another on unfertilezed. One hundred days after planting and sowing the authors examined the absorption of radioactive substances in these plants. As a result of appropriate measurements it was ascertained that in those cases where the soil was not fertilized, the numerical values of radioactivity were correspondingly alike: in beans' leaves 0.42μC/g, in pods 0.15μC/g, in the stems -0.30μC/g; in barley - in leaves 0.09μC/g, in seeds -0.05μC/g; in tomatoes - in leaves 0.27μC/g,

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in the stems –0.16μC/g; in Russian thistle – both in the stems and the leaves –0.15μC/g[9]. The contamination of plants was increased on the fertilized soil (nitrogen, phosphate and potassium fertilizers were introduced). In certain variants the increase of radioactivity reached 30, and in separate cases – even more than 30%. Thus, according to the results of these experiments, fertilizers increase the intensity of the entrance of radioactive substances into the plants. Yet, one should note that the authenticity of these results remains insufficiently proved, and so their interpretation calls for great caution. In these experiments, as well as in those of Egawa (10) and of other researches it was noted that the contamination of seeds and fruits of plants was considerably smaller compared to their other organs. This fact, that fruits and seeds of the plants represent a comparatively smaller danger when used for food is very essential in the daily life.

Larson (13) conducted experiments with radishes and with clover on contaminated soil, situated in the region of the atomic bomb tests (State of Nevada, U.S.A.). Maximum radioactivity of the soil, which was measured 109 days after the explosiion, was equal to 480 counts/sec/g, and the maximum radioactivity of the radish leaves, grown on this soil was 175 counts/sec/g. During repeated determinations of radioactivity, which were conducted 273 days after the explosion, the level of radioactivity decreased

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Footnote[9]: If one should utilize the number of counts per minute instead of the Curie units, then the radioactivity of the plants will be correspondingly: in beans – in leaves $0.42 \cdot 2.22 \cdot 10^6 \pm 0.9 \cdot 10^6$ counts/m, in the pods $0.29 \cdot 10^6$ counts/m, in the stem $0.66 \cdot 10^6$ counts/m, and so on.

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approximately by 1/3, and after 403 days almost to 1/6 of the initial value. The author points out that he did not succeed in determining any definite dependence between the intensity of the contamination of the soil and the degree of entrance of radioactive elements into the plants, and that the degree of contamination of plants is not proportional to the intensity of the contamination of soils.

Approximately this same character of researches was accepted in experiments which were conducted in the region of New Mexico (13). These experiments are interesting in the respect that they were conducted four odd years, after the explosion of the first atomic bomb. Sorghum, corn, peas, cauliflower, lotus and wheat were planted into the contaminated soil. As a result of experiments it was determined, that in grain crops the greatest amount of radioactive substances concentrates in the stalks of plants, then, according to the degree of radioactivity, come the root system and the leaves. Radioactivity in the spikes and in the seeds did not exceed a tenth part of radioactivity in stalks and leaves. In pea plants the greatest radioactivity was noted in the root system, then in the leaves and in peas. The smallest amount of radioactive substances was contained in seeds (half of the amount which was found in stalks and leaves). In lotus and cauliflower a quite different picture was observed. Here the basic mass of radioactive elements concentrated in the green leaves. Thus, the use of vegetables for food presents a much greater danger than of grain crops.

As it was pointed out previously, numerous attempts were undertaken to find out the mechanism of selective absorption by the plants of the mixed [Begin p.65] products of fission. In this respect the experiments of T. Mitikhiko (6) (Japan), of Jacobson and Overstreet (5) (U.S.A.), of Selders,

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Rediske and Palmer (19) (U.S.A.) are of great interest. The experiments of T. Mitikhko were conducted according to a very simple scheme. Clover was sowed on the soil, which was contaminated with radioactive dust. On definite dates (23.V, 16.VII, 18.IX) part of the plants was mowed and reduced to ashes. Five fractions of radioactive elements were isolated from clover ashes according to a method described previously.

When determing the numerical value of each fraction according to dates, it is possible to observe the changes in radioactivity of plants in the space of time. Data referring to this are cited in table 5.

Table 5.

Selective absorption of radioactive substances from the ashes of Bikini by clover, according to data of T. Mitikhiko, and others (Japan).

Fractions of radioactive substances	May 23	July 16	September 18	Remarks
I	2.2	7.3	14	The size of each fraction is given in %. Measurement of radioactivity was conducted 4 days after the mowing of clover
II	2.2	3.2	6	
III^a	91	76	62	
III^b	0.4	1.5	2	
IV	4.0	12	16	

Table 5 shows, that with the passing of time the percentage content of radioactive elements of fraction III^a decreased, but of the remaining fractions it increased. The table, consequently, confirms the really well known fact that the mixed products of fission are enriched in the course of time by those components, which have a comparatively longer period of half life. When interpreting the data of tables, the authors give special attention to those radioactive elements which enter the composition of the IVth fraction,

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that is the alkali-earth elements: Sr, Ba and Ca. The authors emphasize, that after a change in the interrelationship of the products of nuclear fission, which is caused by various periods of half life, precisely this group of elements, as data in the table shows, plays the most important role in the phenomena of selective absorption. But, as it has been pointed out previously, Ca^{45} forms in very negligible quantities, and Ba^{140} has a very short period of half life. Thus, the greatest part of radioactive substances falls to the lot of Sr^{89} and Sr^{90} (mainly to Sr^{90}).

Larson (18) studied the energy characteristics of radioactive substances during the interval of time from three months to a year and a half after the explosion of the atomic bomb.

He has ascertained that the greater part of radioactive substances was represented by Sr^{89}. Interesting data about the reaction of strontium on the soil and plants were obtained by Neel (15). In view of the special role which is played by the radioactive isotopes of strontium we shall pause on them in somewhat more detail.

Absorption of strontium by plants.

The amount of strontium in natural soil is very small (about 0.001%) as it is pointed out by some authors (8). Of course, in plants also the contents of strontium are quite negligible. Studies of absorption of strontium [Begin p.66] by plants were conducted mainly with the aid of radioactive isotopes Sr^{89} and Sr^{90}. These isotopes were isolated from the reactor ashes. Precisely these elements were the most often utilized for various agrotechnical investigations.

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When studying the feeding of plants and during the investigation of the mechanism of the entrance into the plants of radioactive elements, the competition of chemically similar elements was studied. There are indications (16), in particular, about the competitive ability of Sr^{89} and Ba^{140} to calcium. But there are very few data in literature referring to this, that is why it is too early to make here any definite conclusions.

When studying the research data of strontium absorption by the plants one circumstance becomes evident, that almost all of them were conducted without carriers. Thus, the conditions of experiments practically did not differ from those which are created as a result of explosions of atomic and hydrogen bombs (that is, conditions of contamination without carriers).

From among the researches, which were conducted for the study of phenomena of absorption of strontium by plants, we are going to pause, first of all, on experiments by Jacobson and Overstreet (11), which were conducted according to the following scheme. Barley seedlings (three weeks old) were planted in a suspension of calcium-bentonite(10); containing a certain amount of radioactive strontium Sr^{89} (10 microcurie per one liter of solution). After 24 hours the seedlings were taken out from the solution, their roots were washed in water and they were dried. Radioactivity which was found proved to be: in aboveground organs (stalks) -1.6%, in the root system -10.7%. In another experiment by these same authors, which was conducted with sand cultures, the absorption and translocation of Sr^{89} in legumes was studied. The authors record a very poor development of plants and obvious

Footnote (10). This suspension is prepared in the following manner. A saturated solution $Ca(OH)_2$ was added to a 2% electrodialized suspension of bentonite until that time when pH of the solution reached 5.6. The obtained solution was diluted with distilled water, as the result of which the concentration of bentonite was brought to 100 mg/l. In this form the suspension was utilized for the conducting of the experiments.

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signs of damage done to the root system (which was produced by the radiation of Sr^{89}).

Changes in the activity of the three months' old plants have shown the following distribution of Sr^{89} (in counts/sec per 1g of the specimen): in the roots - 3,530, in the leaves - 2,605, in the stems - 1,905, in the beans - 1,115, in the seeds - 7. Mitsui(3) conducted similar experiments with water cultures (experimental plant - soya beans). In these experiments strontium Sr^{90} was introduced into the nutrient medium after the appearance on the stem of 6-7 leaves. Radioactivity of the plants was determined on two dates: in 5 and in 20 days. The amount of strontium, which was absorbed and translocated from the root system into the rest of the plant comprised after five days 9.7%, and after 20 days - 14.8%. Jacobson and Overstreet, who conducted strontium research, also made experiments with barley, which was grown on bentonite suspension, containing Y^{91}, Ce^{144}, Zr^{95}, Te^{129}, Pu^{++}, Pu^{++++}, Pu^{+++}. Experiments have shown that absorption of these elements by the plants proceeds more or less identically. The main mass is absorbed by the root system: Y^{91} is absorbed in the amount of 27.7, Ce^{144} - 27.1, Zr^{95} - 33.5, Te^{129} - 37.2, Pu^{++} - 37.8, Pu^{++++} - 24.6, Pu^{+++} - 20.3%. The aboveground organs contain a much smaller amount, which for yttrium, for instance, comprised only 0.104, for cerium 0.030, for zirconium + niobium 0.003, for tellurium 0.041, for plutonium, correspondingly, 0.010, 0.002 and 0.0004%. Comparing these data with results, which were obtained in experiments with strontium it is easily seen, that Sr^{89} possesses a sharply expressed selective absorption by the aboveground organs of plants. Precisely this peculiarity of strontium creates conditions in the presence of which its relative concentration in aboveground organs becomes, as it was shown above, in hundreds, thousands, and even in tens of thousands of

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times more than the concentration of other [Begin p.67] radioactive substances (for instance, of zirconium and plutonium) in these same organs of plants.

In so far as the intensity of strontium absorption by aboveground organs of the plants proved to be very high, naturally a question arose, what influence the surrounding conditions, especially cultivation and fertilizing ~~produce~~ would have on the absorption of strontium.

In connection with this J. Rediske and A. Selders (17) conducted experiments with beans, where, at an assigned concentration of strontium, pH of the nutritive medium varied (from pH = 4.0 to pH = 7.0). It was established that the concentration of strontium in the root system decreases as the concentration of hydrogen ions increases. But if one examines the concentration of Sr in the leaves one does not discover such a simple relation. On the other hand, if one takes a ratio between a concentration of strontium in the leaves (α) and in the roots (R), that is $\frac{\alpha}{R}$, then this ratio, as the authors point out, is increased as the acidity of the nutrient medium rises. The authors think, that there should exist a similar relation between the acidity of the soil and the degree of absorption of strontium. The given experiments were conducted without the utilization of carriers. It would be interesting to find out if it were possible to reduce the amounts of absorbed Sr^{89} and Sr^{90} by means of an addition of non-radioactive strontium? Rediske and others (17) have conducted experiments with beans with this goal in mind. The nutritive medium in these experiments contained non-radioactive strontium besides Sr^{90}. As a result of these experiments it was established that the addition of non-radioactive strontium increases the total amount of absorbed strontium in the plants, yet the amount of Sr^{90} in proportion to the whole strontium, is decreased. That is why the author

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considers probable a lower absorption by the plants of the amount of Sr^{90} when non-radioactive strontium is added. From the practical point of view the works of Menzel (14) deserve the greatest of attention. The author reports that his work had a purpose to find some means for decreasing the harm from contaminations which arise as a result of tests of hydrogen bombs. Menzel conducted the experiments according to a wide program. Forty-two varieties of soils, taken from different regions in America, were investigated in these experiments. Into each soil specimen, which was previously studied in the agrochemical sense, Sr^{89} was introduced and peas were sowed. After 49 days definite analysis of the soil and plants was conducted. Analyses have shown that between the amount of desorbed calcium and the amount of strontium entering the plants there is an inverse relation (that is, as the amount of the exchange calcium increases in the soil, the intensity of the inflow of Sr^{89} into the plants decreases).

After processing the results of experiments by the usual methods of mathematical statistics, the author comes to conclusion that the examined relation has a completely authentic character(11).

Experiments with barley and buckwheat were conducted (by the same author) approximately according to the same scheme. Soil specimens, which were utilized for sowing these crops, contained, in the word of the author, considerable amounts of Sr^{89} (exact doses are not cited). It was shown, that the coefficient of distribution, numerically equal to the correlation of Sr/Ca (which were absorbed by the plants), ranges in the limits of 0.4-0.5.

Footnote(11). The author cites a graph of the function of $y = f(x)$, where x means the inverse value of displaced calcium in the soil, y-ratio of Sr^{89} to calcium, absorbed by the plant. Conciseness of the article does not permit us to examine this graph, although it is of indisputable interest for the characteristic of the considered relation.

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The author makes a conclusion from the cited data, that the absorption of strontium by the plants can be considerably decreased, if lime will be introduced into the soil.

Rediske and others (17) studied the energy of absorption of Sr^{89} by different [Begin p.68] plants. Experiments were conducted with water cultures at a pH 6.0. The experimental plants were: beans, tomatoes, wheat and Russian thistle.

According to the energy of absorption the plants were disposed in the following order (leaves were analyzed): beans > wheat > tomatoes > Russian thistle. When the roots were analyzed another order was obtained: Russian thistle > beans > wheat > tomatoes. The author also determined the value $\frac{\alpha}{R}$, which, in his opinion, can be regarded as a constant quantity for each plant. Numerical values $\frac{\alpha}{R}$ proved to be alike: for tomatoes - 4.0, for beans - 0.3, for wheat - 0.3, for Russian thistle - 0.1.

Right after an atomic explosion a great part of radioactivity is due to Ba^{140}(12). Menzel (14) conducted investigations on the absorption by plants of Ba^{140}. Results of his experiments proved to be approximately the same as the results of the experiments with Sr^{89}.

The soil factor

Importance of the soil factor, when studying the problem of radioactive contamination, is very poorly investigated. The greater part of works about soils, unfortunately, was not published. There are only references

Footnote (12). The period of half-life of Ba^{140} is 12.8 days. That is why its radioactivity becomes very low even after a comparatively short time. This then explains the fact why most of the authors give so much less attention to Ba^{140} than, for instance, to Sr^{89} and to others long-living elements.

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to the authors and very general information about the experimental data. Amphlett (7) thinks that the ultimate fate of the products of nuclear fission depends not only on their radiochemical properties, but also on a great number of other factors, including the nature and structure of the earth itself (its geology and topology), as well as chemistry and physics of soils and of soilproducing rocks.

Proceeding from aspects of elementary physics and the results of his experiments, Amphlett supposes, that the speed of translocation of radioactive elements in the earth stratum will be in direct relation to the penetrability of the medium, on the presence or absence of clefts and hollows, as well as on the size of capillaries, and of other factors of the most varied character.

The surface translocation will depend on the amount of precipitation. It is greatly increased when there are streams of water. In such a case the soluble material (ionic and certain colloidal forms) will be translocated very fast. The conduct of insoluble forms will depend on various factors: on the size of particles, speed of the flow and other properties of the river's current (on the character of the bottom, on the composition and properties of the bottom formations, and so on), the value and influence of which cannot be foretold in advance.

In the expression of the author, the mechanism for "decontamination" of products of nuclear fission by the soil and the soilproducing rocks is of great interest. Regardless of the obvious importance of this problem, unfortunately, one can find in literature only the most general and very scarce data. Amphlett (7), Selders (19), Menzel (14), and others think that the process of "decontamination" of products of nuclear fission can proceed in

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various ways: by means of ionic exchange (between the elements of the absorbing complex and ions of radioactive substances), by way of adsorption, by means of settling out and filtration, and with the aid of leaching out by rain or ground water. During an ionic exchange such elements as cesium and strontium, can be exchanged with natural cations (for instance, Ca^{++}), which go into the absorbing complex of soils, clays and of other formations. The amounts of absorbed ions of radioactive elements will depend, mainly, on the properties and the type of the clay [Begin p.69] components of the soil. Although many soils have a very low exchange capacity, most of the subsoil rocks have a range of capacity which varies from 30 to 50 meq/100g, which on conversion to one ton of soil material (and when the capacity is expressed not in meq, but in curie-units) gives enormous figures.

Proceeding from wellknown ideas about the mechanism of ion-exchange reactions and utilising his own experimental data, Amphlett (7) calculated approximate quantities of radioactive cesium[13], which can be absorbed when saturating one tone of various soils and of certain clay minerals. The author notes, that these are approximate data and can be utilised only for the determination of the order of the volume of the absorbed cesium.

The exchange of anions, as much as it was little studied, is a less convenient method for studying the phenomena under consideration. In most cases the anion-exchange reactions are characterized by an absorption effect, which is very low and, as the author supposes is more or less similar for all the clays. On the whole, the author considers probable the adsorption of anions by the surface of the soil capillaries, but thinks that the material, re-

Footnote[13]: These data have a decided interest, but due to lack of space we cannot pause on them. They were obtained by a method of dynamic adsorption. Only the concentration and the volume of the solution passing through the core were determined experimentally. The other data were found by calculating (graphic) means. We want to record some details of the experiment: the starting concentration $Cs^{+} = 0.05$ - n; pH of the solution - 7.0; weighed portion of the adsorbent = 5.0g.

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tained in this way, can be easily washed out again. The considered type of ion-exchange reactions is characterised by definite criteria of equilibrium(14), which depend on different factors. Energy of displacement of one ion by another depends, as it is known, on ionic radii and the size of the charge. Being guided, mainly, by these data, the author places the alkali metals (according to the energy of their absorption by clay materials) into the following ascending order: $Li < Na < K < Cs$.

Thus the energy of absorption of Cs by the soil (and clays) will be higher than of other ions of the order under consideration. After the ion-exchange reactions reach a state of equilibrium, the final results depend on the relations of thermodynamic activities of ions, and if the ions have different charges, then also on the general concentration of the solution in equilibrium (more correctly said- on the ionic power of the solution).

These facts have a practical interest besides the theoretical. If the solution contains considerable amounts of inactive ionic material, then this material will take part in the exchange and will produce an influence on the volume of adsorption of the active component. Further on, if the washing solution is acid, the absorption of radioactive ions can be insignificant, as the H^+ ions are more firmly retained, than any other cations.

Finally, the author comes to the conclusion that one cannot depend on the fact that natural soils will behave exactly the same as the laboratory models, whose exchange ability was studied and determined under ideal conditions of the experiment.

Taking into consideration the physico-chemical properties of the products of nuclear fission, some authors suppose that part of radioactive substances will be fully adsorbed when passing through the soil. The other part, which is in a colloidal state, will be adsorbed partially. The in-

Footnote(14). Unfortunately, the author does not give any data about the numerical value of criteria of equilibrium.

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tensity of "decontamination" besides the chemical factors, will depend on the physical condition of the soil and on the dimension of the particles. If the soils have an alkaline reaction, then some (ionic) products of nuclear fission can be deposited (in the form of hydroxides or of carbonates) and later be leached off. This situation complies well [Begin p.70] with the facts, it is true, which are rather scarce (16), which were observed in America. It was pointed out (7), for instance, that the subsoil of that territory which is situated next to the atomic experimental center, proved to be very effective during the "decontamination" of the solutions, which contained, in ionic form, the products of nuclear fission (with the exception of cesium and strontium). This subsoil contains 67% of $CaCO_3$ and has a pH $\doteq$ 8 or 9.

Considerable attention was also given to the studies of leaching of the products of nuclear fission by atmospheric precipitation. Experiments, which were conducted in this direction, have shown, that the anionic forms of activity translocate quite rapidly through the profile of the soil, without revealing any phenomena of absorption. A whole series of works on studying the adsorptive qualities of soils and clays (7,9,12) has shown that the lowland sandy loams, containing montmorillonite and illite, are characterized by high adsorptive properties in relation to cesium and strontium. The soils with a high content of humus have, naturally, a high adsorption capacity (compared to soils with little humus). In one of the examined cases (7) the soil had a low content of humus and its exchange capacity was due exclusively to clay. The author remarks that this soil fixed irreversibly a certain amount of cesium(15), and that such a fixation was not noted on montmorillonite. Ruthenium has interesting adsorptive qualities, as

Footnote(15). Cesium remained in the soil, notwithstanding the attempts to remove it by way of displacing it with other ions.

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it is shown by this same author. Laboratory investigations of $RuCl_3$ show that it is easily adsorbed by the soil which contains montmorillonite and illite. On the other hand the tetravalent ruthenium is adsorbed very poorly. Yet, if the soil, which is used as the adsorbent, is treated with iron sulfate, then the adsorption by ruthenium (from a liquid phase) increases considerably (apparently, thanks to the reduction of Ru^{++++} to Ru^{+++}), and reaches in certain cases more than 99%. Thus, certain products of nuclear fission, which are in ionic form, can be adsorbed (and to a certain degree "decontaminated") by the soil, especially when these soils have sufficiently favorable adsorption properties. One can point out as an example, that the mixture of the carbonates of soil with its surface horizons, which has a sufficiently large volume of capacity and a corresponding value of pH, can be utilized for filling the cores, which possess a high degree of ability for "decontamination".

The fact, deserving attention, is that on several soils, which differ quite sharply in their physico-chemical properties, the order of decrease in radioactivity by means of leaching most often responded to the following order:

$$\text{Ru} > \text{Sr} > \text{rare earths} > \text{Cs}$$

Whereas during the displacement of these same elements from the soil in the process of the exchange adsorption (after treatment in NH_4OH, pH $\simeq$ 7) gives another order:

$$\text{Sr} > \text{Cs} > \text{Ru} > \text{rare earths},$$

which shows that strontium is the most energetically adsorbed, then comes Cs, and so on.

In other experiments, which were conducted with a sandy-clayey soil, possess a very low capacity of absorption ($\approx$6 meq/100g), [Begin p.71]

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it was also found out that ruthenium is much harder to remove from the soil than Cs, Sr, and the rare earths, the energy of absorption of which responded to the following order:

Cs, Sr > rare earths.

One should remark, that the ionic products of fission, which were adsorbed by alkaline soils, cannot be fixed as stably, as they are fixed during the formation of fused compounds (cinders). That is why the entrance of ionic products into the plants (as well as their leaching during acidification of soils) will proceed more intensively in thefirst case, than in the other. Dispersion of ionic products of fission in the soil stratum occurs, as it was already cited, during washing, for instance, with solutions which contain ions Ca^{++}, NH_4^{+}, weak acids, and others. Utilization of lime is often much more desirable, than utilization of weak acids, which represent in themselves a much lower factor for "decontamination" (with the exception, may be, of cases with alkaline soils where acid reagents can play a positive role).

On the other hand,as Neel (15) has shown it, neither acid, nor the alkaline treatment of soil will produce any noticeable reaction on that form of radioactivity, which is in a non-ionic form.

In conclusion we shall examine the Japanese data about the contamination by radioactivity of soils (and soil-producing rocks), and of plants.

<u>Contamination of soils and of soil-producing rocks by radioactivity</u> was studied by several researchers. Having examined the radioactivity of the soils after heavy radioactive rains, Mitsui (2,3) found that the activity of soil specimens, which was measured by a Geiger counter, ranged from 4 to 47 counts/min per g5g. On light soils, which let the rain water pass through easily, as well as on plowed soils, the radioactivity proved to be compara-

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tively low. There was noted no substantial differentiation of the activity in separate horizons.

A large accumulation of radioactivity was found by the author in the imperious horizons of the soil, which let the rain water through very poorly, as well as in the upper layers of soil, which are adapted to different hollows in the terrain.

As an example, the author points that on a comparatively low place (outskirts of the Tokyo University) radioactivity in the upper layer of the soil comprised 47 counts/min, at a depth of 5cm - 4 counts/min, and at a depth of 10cm - 6 counts/min per 5g.

Some authors point out, that the colloidal state of radioactive compounds where one meets the rare earth elements more often, as well as zirconium and niobium, can be utilized quite successfully when purifying the contaminated water (21). These compounds sometimes can be removed together, with calcium phosphate, alum, or ferric hydroxide. This same can be achieved also by means of filtering the solution through calcined clay (20). The effectiveness of the removal of radioactive elements can be increased by the addition of calcium phosphate to the clay. In like cases, as the authors point out, Ce^{144} and Sr^{89} are held back in considerable amounts. The researches by Mitsui (2,3) and others show that radioactive substances, brought with the rain, are retained in the upper layers of soil and remain there for a lengthy time. During atom bomb tests in America, it was also noted that contamination of the soil is limited chiefly to its upper layers. Iodine, as well as strontium are the exceptions as much as they are characterized by a greater solubility. Yet, even these elements, in the opinion of the author, cannot penetrate to a very great depth. L. Jacobson and R. Overstreet (11) added to a suspension of bentonite - calcium various radio-

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active elements (yttrium, cerium, zirconium, niobium, [Begin p.72] tellurium, and others. After a definite time of interaction the suspension was centrifuged.

When examining these centrifuged substances, it was found that bentonite adsorbs the following amounts of the radioactive elements: Y^{91}-98.6%, Ce^{141}/Ce^{144}-94.8%, Zr^{95}/Nb^{95}-98.6%; Sr^{89}-60.4%, Te^{127}/Te^{129}-30.2%, PuO_2-18.6%, Pu^{++++}-66%, Pu^{+++}-94.2%.

The cited data show, that as a matter of fact, all radioactive elements possess a great coefficient of absorption (for a given adsorbent). Yttrium, zirconium and niobium have a specially high coefficient. The great energy of absorption of zirconium and niobium was also noted by Vlamis and Pearson (22). They point out that clay and soil adsorb very fast zirconium and niobium, which then are removed with great difficulty. These same authors passed through the soil solutions of certain radioactive substances. Examination of filtrates has shown a full absence of radioactivity.

Larson (13) points out that in the upper layers of the soil very many radioactive substances which were formed as a result of the atomic explosion, are in an unsoluble form, and that they cannot be removed from the soil even with a large amount of water. The amount of water-soluble substances, depending on the type of the atomic explosion, reaches 10%.

Noel and others (16) note that the energy of absorption of radioactive substances by various clayey rocks is different. Some of the Japanese researchers have established that the overwhelming majority of radioactive elements concentrates in the layer of soil to a depth of 0.5 cm from the surface. On the other hand, researches of Egawa (10) show that strontium clearly goes into the deep layers of soil.

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Contamination of the plants by radioactive substances through the root system, as it is seen from the examined facts, at first proves to be very insignificant. This contamination increases with the deepening of these elements to those layers of soil in which the basic mass of the root system is concentrated. If one should cultivate the land right after the radioactive rains, then, as the author remarks (10) radioactive substances which are found on the surface of the earth will be plunged into deeper layers, where they will become more accessible to the root system of plants. Owing to this, the absorption by the plants of radioactive substances will increase. Measuring, with the aid of a G.-M. counting tubs, the radioactivity of vegetation after the radioactive rains, which fell in the southern regions of Japan on 16-17 May, 1955, Mitsui and Iamadzaki (17) have established that for different plants it ranged in the limits of 50-500 counts/min per 1g of substance. An especially strong activity was registered in plants which have uneven surfaces (spikes of grains, leaves of radishes, and others). On conversion to 1 sq. foot of the surface the greatest value of the activity reached the order of 10^6 counts/min. For a comparison the authors cite some data about the results of tests of atomic bombs, the seventh in order of tests, conducted in U.S.A.[16].

Among the plants, whose radioactivity was being determined after these tests, the strongest contamination was noted in agrimony and in dandelion. Radioactivity of these plants proved to be correspondingly equal to $0.2-2.0 \cdot 10^6$ and $0.3-1.6 \cdot 10^6$ counts/min for 1 sq. foot.

Footnote[16]. The question is about the testing of an atomic bomb, which was conducted on April 25, 1953 in the state of Nevada. As a result of this testing the products of nuclear fission, which were carried across the whole American continent, fell with a downpour, which was accompanied by thunder, in the region of the city of Troy (New York state), which was situated 2,300 miles from the place of the explosion.

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The problem of radioactive contamination of the vegetable cover and of soils, which arose as a result of tests of hydrogen and atomic bombs draws [Begin p178] to itself more and more attention. In proportion to the development of research and the accumulation of factual data, the importance of this problem becomes ever more obvious. Yet for a full solution of the problem, as some of the researchers correctly suppose, there are no other ways but to forbid the tests of atomic and hydrogen bombs.

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Soil Institute im. V. V. Dokuchaeva
of the Academy of Science USSR

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(In full)
vg/M

Fliagina, A. V.

Preparaty, ispytannye protiv sosushchikh vreditelei khlopchatnika.

[Preparations, which were tested for the control of sucking pests of cotton].

Zashch. Rast. ot Vred. i Boleznei, no. 1. p.47. Jan./Feb. 1957. 421 Z1

(In Russian)

A 827

The preparations used, at the present time, for the control of agricultural pests do not always answer the requirements which are set forth to them as insecticides, and this calls for a necessity of looking for new, more effective means. In connection with this a Station for Plant Protection of the SoiuzNIKhI [All-Union Cotton Scientific-Research Institute] conducts annually an examination of new preparations, which are synthesized by NIUIF and other scientific-research institutions.

During the period from 1952 to 1955 the Station for Plant Protection examined phosphorus organic preparations and chlorinated terpenes. Laboratory and field tests were conducted with them on cobweb mites, as well as with melon patch and acacia aphids.

Almost all the phosphorus organic preparations tested by us for their toxicity for the control of the cited pests surpass the chlorine organic preparations or the chlorinated terpenes. Thus, for instance, "karbofos" [carbophos] guarantees a 50% mortality of melon patch aphids and of the cobweb mites at a concentration of 1 and of 5g in 10L., and a 100% mortality at a concentration of 2 and 20g in 10L., whereas, for instance chlorten guarantees a 50% mortality of these pests at a concentration of 10g in 10L.

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and a 100% mortality of the melon patch aphids at 60g in 10L. In comparison with the 10% "metafos" the chlorten concentrate with DDT becomes lethal for the acacia aphid if the dose will be increased by 30 times, for the melon patch aphid by 10 times and for the cobweb mite by 20 times.

Field experiments for determining the effectiveness of preparations for the control of cobweb mites were conducted in a kolkhoz imeni Sverdlov, Iangi - Iul'skii raion in Tashkent oblast'. Treatment of cotton was conducted with a OUN-4 machine at an outlay of the solution of 1200 L/ha [hectare = 2.471 acres]. The preparations tested were all of a similar concentration - 0.5%. In all, 10 variants of the experiment were started in 2 replications, 0.5 ha for each. ISO [Lime-sulfer decoction] with anabasine sulfate was taken as a standard because the treatment was contemplated for the control of the cobwed mite and of aphids; during the evaluation of effectiveness very few aphids were found.

Below we give data about the results of experiments of preparations under field conditions.

Effectiveness of preparations for the control of cotton sucking pests

Preparation	Toxicity in % (with a correction for the standard) after:	
	5 days	10 days
65% "khlorfen "[chlorphen?] photochemical	90.0	72.6
65% " " dark	56.7	50.0
65% chlorten	93.0	76.3
65% chlorten with DDT	75.1	47.8
65% polychlorpinene	65.8	66.9
65% polychlorcamphene	85.6	78.5
"Vofatoks" [Vophatox?]	77.0	10.0
30% thiophos emulsion - standard	91.5	54.0
ISO / anabasine - standard	-	61.2

As it is seen from data cited in the table the photochemical chlorphen proved to be the most toxic of the two. Under field conditions the chlorten preparation was close to the photochemical chlorphen in its effectiveness;

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chlorten with DDT was less effective, than chlorten merely alone; polychlorcamphene was more effective than polychlorpinene.

Furthermore, from the above data it is seen, that in time the examined preparations lose their toxicity to one or another degree, some quite strongly. Thus, the thiophos emulsion on the fifth day of evaluation showed a good effectiveness, but on the 10th day it was lowered to 54%. A sharper reduction in effectiveness was shown by vophatox - down to 10%.

During production tests in 1954 vophatox also proved to be little effective for the control of the cobweb mite. Consequently, this preparation while being highly toxic in respect to sucking pests under laboratory conditions, looses strongly its properties on the 10th day under field conditions.

Phosphorus organic preparations in their toxicity surpass the chlorine organic in the control of aphids and of cobweb mites. Metaphos and vophatox guarantee a 100% mortality of aphids at much lower concentrations, than the standard - anabasine sulfate; that is the reason why they should find a wide utilization for the control of the cited pests. For the control of the cobweb mite metaphos and vophatox can be recommended only in a mixture with ground sulfur.

Chlorine organic preparations for the control of sucking pests of cotton cannot be recommended, as they are little effective.

City of Tashkent, All-Union
Scientific-Research Institute
of Cotton Growing.

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Trans. A-828
(In Full)
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Gar, K. A., and Gramin, E. F.

Ispytanie novykh preparatov dlia pred-posevnoi obrabotki semian sakharnoi svekly.

[Examination of new preparations for pre-planting treatment of sugar beet seeds].

Zashch. Rast. ot Vred. i Boleznei, no. 1. p.46. Jan./Feb. 1957. 421 Z1

(In Russian)

A 828

It is known, that during the first days after the appearance of sprouts on the surface of the ground they are very sensitive to the damage that is being done them by beet Curculionidae. Often these pests destroy beet sprouts below the surface of the soil.

Spraying or dusting the plantations with poison chemicals during this period is not sufficiently effective.

In connection with this several researchers got an idea to make the sugar beet sprouts poisonous for the pests by means of preplanting treatment of seeds with insecticides.

The first experiments which were conducted in this direction in 1949 in the Institute of Entomology and Phytopathology of AS Ukrainian SSR (by Kititsin) have shown promising results. Hexachloran, which was utilized for this purpose under laboratory conditions, caused high mortality in Curculionidae, although under field conditions the effect was not always clearly expressed.

In the Scientific Institute on Fertilizers and Insectofungicides, during the last two years, new poison chemicals were tested, which deserve serious attention as a medium for preplanting treatment of beet seeds. Into these experiments were included highly toxic insecticides: chlorindan,

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heptachlorine, aldrin, dieldrin, isodrine, and endrin. Hexachloran was utilized as a standard (both the technical product, as well as the one enriched with gamma isomer up to 99-100%).

Results of our research and of literary data indicate that the new insecticides are more poisonous to many kinds of insects during treatments of green plants than are DDT and hexachloran; and dieldrin and endrin even surpass DDT in the length of the aftereffect.

Experiments in preplanting treatment of seeds were conducted in the field on small sections. The moistened seeds were dusted before planting with a definite amount of finely ground crystalline insecticides. The effect was determined by utilizing glass bowls, which were placed on the sections, and evaluation was done at different intervals of time after the appearance of the sprouts. The mortality of beetles was computed, depending on climatic conditions, on the second or fourth day after the adding of beetles to the isolators.

The table shows results of two experiments when the Curculionidae were placed into the isolators on the 9th day after the appearance of plants. These experiments have shown definitely that all the tested insecticides caused toxicity in the beet sprouts; aldrin, endrin, and, especially, isodrine surpassed hexachloran in toxicity.

Hexachloran in large doses retards the sprouting to a considerably larger degree than the new insecticides (see the table).

Insecticide	Date of tests	The length of beetles' stay on the sections	Number of infected beetles (in %) at the following doses of poison chemicals	
			4g per 1 kg of seeds	8g per 1 kg of seeds
Aldrin	1955 May 25	5 days	89	-
Heptachlorine	same	same	70	85

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Table continued

Insecticide	Date of tests	The lenght of beetles' stay on the sections	Number of infected beetles (in %) at the following doses of poison chemicals	
			4g per 1 kg of seeds	8g per 1 kg of seeds
GKHTSG, technical	same	same	62	78
Chlorindan	"	"	43	76
Isodrine	1956 May 6	4.5 days	90	94
Endrin	same	same	73	87
Aldrin	"	"	76	77
Dieldrin	"	"	-	44
Gamma-isomer GKHTSG	"	"	33	-

Observations on sections have shown that isodrine in a dose of 4g per 1 kg of seeds did not cause any delay in the growth and development of sprouts of beets, while the gamma isomer GKHTSG (99-100% pure) on the contrary, acts depressively in the same dosage. Similar results were obtained under laboratory conditions during the evaluation of the energy of sprouting of treated seeds.

From all the above cited one can come to conclusion, that the three new insecticides, aldring endrin and isodrine are very promising for the pre-planting treatment of beet seeds.

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Klimashevskii, E. L.

Primenenie geksakhlorana i mikroelementov.

[Utilization of hexachloran and of microelements].

Zashch. Rast. ot Vred. i Boleznei, no. 1, p.48-49.
Jan./Feb. 1957. 421 Z1

(In Russian)

Conclusions

Utilization of hexachloran for preplanting powdering of seeds, dusting of the stand of grass or introduction of it into the soil lowers the damage done by wireworms to the root system of clover; it produces a stimulating influence on the growth of the plant and, thus, on the yield of grass.

A simultaneous preplanting treatment of clover seeds with hexachloran and a microelements' solution gives the greatest increase in the yield of grasses.

Under the influence of the preparation GKHTSG the percentage of damage to the clover heads produced by the Curculionidae, seed-eater, Apion apricans Hrbst., is decreased.

Hexachloran produces a stimulating effect on the growth of the bacteria, which are capable of fixing free nitrogen (azotobacter). The effectiveness of hexachloran's action is increased when it is used together with microelements.

There is not much difference in the effectiveness of its action when hexachloran is introduced into the soil or the seeds are dusted with it before planting. Thus, the last method, being more practicable, should be

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introduced widely into production as a method which increases the yield of perennial grasses.

Sverdlov Oblast' Experimental
Station in farming.

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(In full)
VG/M

Guliakin, I. V., and Iudintseva, E. V.

Postuplenie v rasteniia radioaktivnykh izotopov strontsiia, tseziia, ruteniia, tsirkoniia i tseriia.

[Radioactive isotopes of strontium, caesium, ruthenium, zirconium and cerium as supplied to the plant].

Akad. Nauk SSSR. Dok. vol. 111, no. 1, p.206-208.
Nov. 1, 1956. 511 P444A.

(In Russian)

In connection with the obtaining of radioactive isotopes, which permit one to detect in plants very small amounts of such elements as strontium, caesium, cerium, ruthenium, zirconium and others, a wide examination was started of the entry and of distribution within the plants of the so-called rare and sparse elements.

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830

In many works (1-6), which were conducted in various soils, it is pointed out that radioactive isotopes of cerium, caesium, yttrium, ruthenium and zirconium (with daughter isotope niobium) are absorbed slower by the plants and are held back mainly in the roots unlike radioactive isotopes of strontium, which enter the plants more intensively and accumulate in aboveground organs in considerable amounts.

Our examinations of the entry of radioactive isotopes of strontium, caesium, zirconium and ruthenium were conducted with the plants of wheat (Triticum persicum) in water cultures on a nutrient medium with an addition of boron and manganese.

Taking into consideration a different coprecipitation of radioactive isotopes in the nutrient medium, the experiment was conducted according to

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a method of fractionated nutrition: radioisotopes were in vessels with water from the water supply separately from the nutrient medium; and the plants daily were alternately rearranged from the nutrient medium into the vessels with radioactive isotopes and back. Concentration of isotopes was 0.05 mc per liter or 0.325 mc per vessel with a holding capacity of 6.5 L.

Table 1*

Contents of radioactive isotopes in plants at the end of the tillering stage of wheat

Isotopes	per 1 plant				per 1g of dry substance	
	Aboveground parts		Roots		Aboveground parts	Roots
	Thousand Counts/min	%	Thousand Counts/min	%		
Sr^{90}	40.8	78.3	11.1	21.7	108.1	90.2
Cs^{137}	44.6	59.1	30.8	40.9	166.3	537.2
Zr^{95}	0.2	2.1	9.3	97.9	0.8	72.0
Ru^{106}	0.4	0.5	78.6	99.5	0.7	757.7

Footnote* In table one, as everywhere following, a total activity is shown for those having daughter radioactive nucleids Sr^{90}, Zr^{95} and Ru^{106}, (that is $Sr^{90} + Y^{90}$, $Zr^{95} + Nb^{95}$ and $Ru^{106} + Rh^{106}$). The time, which passed between the time of harvesting the plants and the measuring of activity, was sufficient for the establishment of a balanced ratio between Sr^{90} and Y^{90}, and the more so for Ru^{106} and Rh^{106}; that is why the measured activity in the given case is in proportion to the contents of the mother long-living isotope, that is Sr^{90} or Ru^{106} respectively. Small deviations from a balanced ratio were possible for $Zr^{95} + Nb^{95}$.

[Begin p.207]

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Data of evaluation (table 1) show that radioactive isotopes of strontium and caesium accumulate, for the most part, in the aboveground section of the plant, while the radioisotopes of zirconium and ruthenium are retained mostly in the roots. To the end of the vegetative period of wheat the contents of radioactive isotopes in plants increase. Furthermore, radioactive isotopes (table 2), strontium and caesium, become accumulated comparatively stronger in the aboveground parts of plants.

Table 2.

Distribution of radioactive isotopes in parts of ripe wheat plants

Parts of plants	In thousand counts per min for 1 plant				in per cent			
	Sr^{90}	Cs^{137}	Zr^{95}	Ru^{106}	Sr^{90}	Cs^{137}	Zr^{95}	Ru^{106}
Leaves	93.2	272.9	0.6	1.7	43.6	27.4	8.6	1.5
Stems	87.5	383.7	0.6	2.1	41.0	38.4	7.0	1.9
Spike (without grain)	12.9	123.6	0.1	0.9	6.4	12.4	1.2	0.8
Grain	3.9	47.3	0.03	0.06	1.8	4.8	0.5	0.1
Roots	15.4	169.4	5.9	104.1	7.2	17.0	82.7	95.7

Entering intensely into the aboveground part of wheat, radioactive isotopes of strontium and caesium are accumulated in the grain to a considerably larger amount, than radioisotopes of zirconium and ruthenium.

Data of table 2 show, that in the roots of ripe wheat there is contained only 7.2% of Sr^{90}, but 17.0% of Cs^{137} from the total amount in the whole plant. These data about the entry into the plant and distribution of radioactive isotopes through it were obtained under conditions of an experiment when there was noted almost no negative effect on the growth and yield of wheat.

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Table 3.

Isotopes	Air-dried weight in % from the control			Contents of isotopes in mc/kg		
	Grain	Straw, chaff	Roots	Aboveground parts	Roots	Grain
Sr^{90}	88.2	116.5	104.5	0.26	0.43	0.017
Cs^{137}	96.7	90.9	96.6	0.67	3.7	0.13
Zr^{95}	104.8	105.6	84.8	0.012	1.9	0.0011
Ru^{106}	121.0	130.7	125.8	0.015	6.7	0.00054

Contents of radioactive isotopes of caesium and strontium per one unit of dry substance of the aboveground mass, especially of grain, is greater, than the contents of radioisotopes of zirconium and ruthenium (table 3). Per unit of grain weight the highest content proved to be that of Cs^{137}, Sr^{90} somewhat smaller, and still smaller were Zr^{95} and Ru^{106}.

The cited experiments, conducted by us with many agricultural plants, (sentence continues on page 208, after table 4)

Table 4.

Isotopes	Weight of plants in % to control			Contents of radioisotopes per one plant of oats					
				In thousand counts/min in 1 plant			% from the total content in aboveground mass		
	Grain	Straw	Chaff	Grain	Straw	Chaff	Grain	Straw	Chaff
Sr^{90}	48.0	98.3	92.9	127.0	5270.1	213.6	2.3	93.9	3.8
Cs^{137}	31.5	100.0	85.2	281.5	4745.6	443.2	5.1	86.8	8.1
Ce^{144}	84.9	74.1	92.9	1.0	45.8	1.0	2.1	95.8	2.1

[Begin p. 208]

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have shown, that radioactive isotopes, which enter into the aboveground part of the plant, of such elements as Sr, Cs, Cd, Ru and Zr are contained mainly in vegetative parts and, in a comparatively insignificant amount, in the reproductive organs.

During an experiment with oats (Moskovskii A-315), which was conducted with a concentration of radioactive isotopes fof 1 mc per liter of solution, there was seen a decrease in the yield of grain (table 4).

Data of table 4 show that notwithstanding a damaging effect of radiation on the oat plant the same regularity of distribution of radioactive isotopes is retained among the different aboveground parts as in wheat, where there is an absence of a negative influence on the growth and yield of plants.

Moscow Agricultural
Academy imeni K. A. Timiriazev

Entered on
July 24, 1956

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At Readers' Conferences

Na konferentsiiakh chitatelei.

Zashch. Rast. ot Vred. i Boleznei, no. 1.
p.7. Jan./Feb. 1957. 421 Z1

(In Russian)

If one takes into consideration the circulation of the journal, which constitutes now about 25 thousand (and this figure, undoubtedly, will increase with the publication of every new number of the journal), and compares this with the presence in our country of scientific workers in the field of plant protection (about 3 thousand), then it appears that the basic mass of the journal's subscribers is composed of the agriculturists of MTS, of kolkhozes, sovkhozes, squadrons, expeditions and other production organizations which are engaged in the control of agricultural pests, diseases and weeds. And this basic mass of readers must be taken into consideration.

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(Abstract)
vg/M

Kurkovskii, S. Ia.

O nekotorykh nedostatkakh mashin,primeniaemykh dlia bor'by so sveklovichnym dolgonosikom.

[About certain deficiencies in machines which are utilized for the control of beet Curculionidae].

Zashch. Rast. ot Vred. i Boleznei, no. 1. p.21-24. Jan./Feb. 1957. 421 21

(In Russian)

In 1955-56 the Ukrainian MTS were supplied with new machinery for the protection of plants. In 1956, in Kharkov oblast' for the control of beet Curculionidae were utilized: a cutting trench digger KF-30, sprayers ONT-12 and OKM and the combination sprayers-dusters OKS, OKP-15 and ONK. They were all tested for their performance.

Trench digger KF-30 is intended for digging trap trenches. Four machines were tested. The depth of the open trenches ranged in the limits of 200-300 mm, and the width-160 to 180 mm, which was satisfactory. In compact chernozem soils with a mean moisture content of 24-28% the quality of trenches was excellent. On loose soils, on fields of last year beet plantings, with a moisture content of 28-30% the trenches had ragged sides and needed much additional manual labor for cleaning out.

A 832

Productive capacity of trench diggers was far below the calculated. They only dug 5-8 km per day instead of the 13-15 km, a norm established by MTS. This is explained by technical troubles and the overloading of tractors.

The basic defect of the machine was the unreliability of the chain-drive. Also, on all the tested machines the braces of the hoisting winch became deformed or even broke. The steel trusses of the hoisting mechanism

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also broke in many cases. The knives of the cutting drum were subject to considerable wear and tear, became dull; this increased the effort of the machine and worsened the quality of trenches.

The traction force of the trench digger was very great. The tractors became over-loaded and in one case we registered 13 stoppings during 1 hour which were caused by straining.

At a moisture content of 25% and higher in the soil, the clogging of the moldboard was very heavy and required frequent stops for cleaning.

Sprayer ONT-12 (FP), mounted on tractor U-2.

Two machines were tested in sprayings of 5% solution of barium chloride with an addition of 1% of molasses. During observations the wind achieved a velocity of 2.5-3.0 m/sec. The quality of spraying was satisfactory, but only at those times when we succeeded to adjust the machine, and it went out of order very often, especially in the distributing system.

We found many defects in the sprayer. The extension arms of the nozzles broke down very easily, the boom sprayer was too heavy, it had nothing to prevent it from hitting the ground, it was very hard to back the engine, the gear wheel wore out very soon and thus the pressure of the stream was lowered.

The quality of production of the machine must be recognized as low.

Horse-motor sprayer OKM. At the Sverdlovski beet sovkhoz, in Kharkov oblast' two OKM sprayers were hitched to one tractor KhTZ-7. The coupling was made on the farm. The constructional covering of the unit was 11 m, while the economical (working) was somewhat greater: 12.0-12.5 m (wind dispersed the pulverized stream to 1-1.5 m). When the tractor worked in second gear the productivity of the unit reached 5.8 to 6.3 ha (hectare = 2.471 acres) per one hour of net work. The filling of the reservoir was manual, by pails.

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Although the sovkhoz gave the OKM sprayer a positive evaluation, they found a few defects: for instance, small holding capacity of the reservoir; the motor, of a ODV-300V type became overheated very soon, after which it was very hard to start it again; the seat for the driver was extremely uncomfortable, having no cushioning, and almost impossible to use during the tractor's pulling.

Combination sprayer-duster OKS was utilized for spraying beets with a field atomizing device. The work of four OKS machines on the farm went along uninterrupted. But the productivity ranged, on the average, in the limits of 20-30 ha per working day, which was unsatisfactory under the given conditions. But this was explained exclusively by a bad organization of work.

When tractor U-2 worked in the first gear, the diameter of the atomizing nozzle being 4 mm and the working pressure 15-20 atm, the actual outlay of liquid per 1 ha comprised about 620 L, which is superfluous. But the workers did not deem it necessary to lower the outlay. We found excessive moistening on a strip about 2-2.5 m wide.

Among the defects of the OKS machine were noted: a quick wearing out of the toothed rack transmission of the swing branch pipe, which was situated very low above the ground without any protection; in one case was noted a lowered productivity of the filling ejector (not more than 50 L/min) and in another case a rattling noise was heard in the link gear of the plunger pump.

Combination sprayer-duster OKP-15 from the "L'vovsel'mashin" factory was used as a sprayer on beets. The machine had a spraying device in the form of two spray nozzles oppositely situated horizontally.

The work of OKP-15 machines was observed by us at two kolkhozes and the obtained data almost fully correspond.

At both farms beets were sprayed by way of a shuttle motion of the units across the rows at a right angle to the wind.

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During observations the intensity of the wind reached 4-5 m/sec which was not a quite favorable condition for the work of this type of spraying device.

The examination showed that the covering of beet leaves with poison chemicals was not uniform. The basic mass of the liquid settled in the form of coarse drops at a distance of 4-4.5 m from the axis of the movement and further on in a form of a strip 5-6 m wide. In this zone too much liquid settles onto the plants while in the immediate proximity of the machine large drops fall of a diameter 5-7 mm. A covering which was satisfactory in quality, with fine droplets, was only noted at a distance of 10-12 m from the machine and further up to 30-35 m with a gradual decrease in density. The discs in the sprayers had openings of 2 mm diameter, the working pressure was 15-16 atm and the speed of the unit's motion was 5.25 km/hour. The outlay of liquid was 350-360 L. per ha.

The productivity of the unit was 16-19 ha per one hour of net work, but on account of frequent stoppings for technical and organizational reasons the daily productivity did not exceed 20-25 ha. Later on it began to increase as the workers of MTS fixed many defects in the machines.

<u>A combination sprayer-duster ONK,</u> mounted on tractor KHTZ-7. We observed two machines, which worked as sprayers with a horizontal distributing boom sprayer.

Working on beets during a wind up to 5 m/sec the width of the working covering (the economical width) reached 11 m, while the constructional covering of the boom was 8 m.

With the working of the full complex of nozzles (20 pieces) having openings of a diameter 1.5 mm, a working pressure of 7-8 atm and the speed of movement of the unit 5.3 km/hour (second gear) the outlay of liquid (reckoning 175g of DDT emulsion concentrate per 10 L. of water) constituted about 250 L. per 1 ha. Productivity per 1 hour of net work ranged in the limits of 5.5-5.8 ha, whereas the average daily productivity of the unit,

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which was calculated during the course of three working days, did not exceed 20-25 ha. Much time had to be spent for the refilling of reservoirs, because their holding capacity was very small. There were almost no stoppings for technical reasons. The farms gave a high evaluation to the cONK machines.

The following defects can be pointed out in this machine: small holding capacity of the reservoir; insufficient productivity of the ejector; the distributing boom gets rickety on the vertical plane; the end nozzles of the boom sprayer, having no support, hit the ground and turn back, thus the cone of dispersion was turned backwards instead of downwards; the seat for the workman was very bad; the mounting device was very complicated and took a long time to mount; the steering device was very dispersed and this made the operation of the machine difficult.

Kharkov Agricultural factory
imeni Dokuchaev.

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Trans. A-833
(In full)
vg/M

Kosov, V. V.

Osnovnye zadachi v 1957 godu.

[Basic problems in 1957].

Zashch. Rast. ot Vred. i Boleznei, no. 1:
p.3-6. Jan./Feb. 1957. 421 Z1.

(In Russian)

The Soviet people are successfully accomplishing the problems which were set up by the 20th Congress of the Communist Party of the Soviet Union concerning a sharp rise in socialistic agriculture. The kolkhozes and sovkhozes of our country in 1956, the first year of the Sixth Five-Year-Plan, have considerably increased the production of grain, potatoes, flax, cotton, milk and other forms of provisions and raw materials for industry. The standard of government procurements in many of the most important products during the past year reached unprecedentedly high indicators, attesting to the growing power of the Soviet state. The supplying of people with products of nutrition, and of industry with agricultural raw materials improved considerably.

In the new year, 1957, a problem was raised before kolkhozes, sovkhozes, machine-tractor stations, as well as before all the agricultural workers of our country to multiply the successes of the past year, to provide for a continuous growth in the yielding capacity of agricultural crops and the advance in productivity of animal husbandry, to achieve further increase in the output of agricultural production.

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For a practical solution of this problem a well organized control of pests, diseases and weeds, and of losses, which in many cases still achieve immense proportions, is of great importance.

According to calculations of VIZR, annual losses of grain in USSR from pests and diseases alone reach 800-850 million puds, of cotton fibre - 500 to 600 thousand tons. Late blight alone carries off 2 to 2.5 million tons of potatoes. Total losses which the kolkhozes and sovkhozes bear yearly from losses in yields on account of damages inflicted by pests and diseases to crops and plantings are estimated in billions of rubles.

Our country gives much attention to the protection of plants. It is sufficient to say, that from the Union budget alone more than 180 million rubles were expended for the control of pests and diseases in 1956, and the supply of poison chemicals to agriculture exceeded 300 thousand tons. Extermination works for the destruction of various pests during the past year were conducted on almost 23 million hectares; this includes over 11 million ha. [hectare = 2.471 acres] for the control of susliks and mouse-like rodents. The volume of measures for the control of sugar beet, cotton, fruit and vegetable crop pests has grown considerably, as well as for the most dangerous of all pests of grain crops - Eurygaster integriceps Put.

Yet, the results of the conducted works lag behind that which is desired.

In this respect there are many serious defects. For instance, let us take the problem of the Eurygaster bug. Last year in many raions of the Northern Caucasus (Krasnodarskii Krai, Rostovskaia and Kamenskaia oblast') as well as in raions along the Volga (Saratovskaia, Stalingradskaia, Balashovskaia oblast'), considerable areas of grain crops were infested by this pest, which led to a lowering in the yielding capacity and in the quality of grains, as it did in previous years. According to the most

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modest calculations sheer losses, incurred by the national economy from the Eurygaster bug, last year were 75-80 mln puds of grain, to say nothing about the lowered quality of the harvested grain.

The cause of such a huge loss, which was brought on in 1956 by the Eurygaster bug, consisted mainly in a bad organization of the protection of plantings from this pest, which to a large degree depended on the attitude of leaders of agricultural agencies, of MTS of kolkhozes and sovkhozes, whose fields were infested by the bug towards this big and important task.

In Krasnodarskii Krai, where the control of Eurygaster bug, by means of dusting the infested fields with DDT dust, was begun early and, notwithstanding the unfavorable climatic conditions, was persistently conducted until June, in most raions it became possible not only to protect [Begin p.4] the crops of winter wheat on all infested areas from big losses, but also prevent the lowering of the quality of grains.

In Stalingrad oblast' a different situation was created. Here the extermination works of the Eurygaster bug were begun very late, because of waiting for the delivery of vofatox and they were conducted with negligence and poor in quality. As a result of this the Eurygaster bug damaged the grains on an area of 150 thousand of ha. For that same reason in Balashov oblast' almost the seventh part of all the grain shipments, which entered the storage points in 1956 had up to 10% of grain which was damaged by the Eurygaster bug, which sharply lowered its baking qualities.

These losses could have been considerably lowered if the organization of protective works was better and, chiefly, more timely, as well as the handling of poison chemicals was more expert, as locally they were in sufficient supplies. It is indisputable, that vofatox in many cases is better than DDT in providing a higher and more assured effectiveness, yet DDT with an expert handling can also be of great use.

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The lessons of the past year urgently require a more careful and timely preparation for the control of the Eurygaster bug.

The problem is not to only guarantee the effective protection of crops in the current year, but also to prevent a further enlargement of the areal of this pest and in the next years to succeed in a sharp lowering of its harmfulness. Data of scientific investigations and of practical experience show that modern chemicals do not produce full destruction of the Eurygaster bug, and for a radical decision of the question of extermination of this pest it is necessary to change the system of its control by linking the chemical measures with agrotechnical, and, especially, with organised technical action during harvesting of the crop.

Observations show, that the numbers of the Eurygaster bug grow and the areas of infestation of crops become enlarged to a considerable degree when the harvesting work is delayed. It is established that for a normal overwintering the bugs must have a sufficient amount of fat (35-45% to the dry weight of the body), which they basically acquire from the ripening grains; the bugs which do not have such a store of fat are doomed for mass extermination. Consequently, in order to prevent a further propagation of the pest it is necessary to conduct early harvesting of grain crops in all the regions of its settlement and eliminate the losses; this becomes possible with the organisation of a divided harvesting of the crops.

Estimates have shown, that for conducting separate harvestings of grain crops on the entire area, which was infested with the Eurygaster bug, in the current year it would be necessary to have approximately 8 thousand grain binders and 12 thousand combines. Our industry is quite capable to furnish the regions where Eurygaster bug is spread, with this amount of harvesting machines. Thus, there is a full possibility, already in 1957, to attack the

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Eurygaster bug on a wide front and in the next years to succeed to so lower the numbers of this dangerous pest that it would become inappreciable.

This will give the possibility to considerably improve the quality of grain obtained, together with a saving of tens of millions of puds of crops in the regions where the most valuable varieties of wheat are grown; and in the future to also lower the outlay in financial and material resources for the control of this pest.

Simultaneously with the realization of wide measures for the control of the Eurygaster bug it is also necessary to considerably enlarge the work of protection of grain crops from other pests. Special attention must be given to the protection of corn from wireworms, which bring great harm.

Serious consideration must be given to the sugar beet Curculionidae. During last year it was possible to avoid any large damage to the plantings of sugar beets. In this a positive role was played not only by the protective and exterminating measures, which were undertaken, but also by favorable weather conditions which then prevailed. Yet, as in the foregoing years, active control of this pest in most of the regions of its spreading was terminated as soon as it stopped being a real threat to the sugar beet crops. Unfortunately, in many regions, which plant sugar beets the harmfulness of such practice is not properly evaluated; [Begin p.5] this permits the overwintering of a considerable part of beetles and brings on the growth in their numbers during the following year. The kolkhozes and sovkhozes during this year will be much better supplied with poison chemicals and apparatus for the control of beet Curculionidae and other pests of sugar beets. Side by side with the increase of deliveries of barium chloride, of DDT emulsions and of hexachloran, the farms which plant beets will receive DDT paste, polychlorpinene, as well as the 25% hexachloran dust for introducing into the soil in order to exter-

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minate the larvae of beetles.

This will permit to set a goal in the current year before the agricultural organs, MTS, kolkhozes and sovkhozes, which plant beets, to not only protect all the plantings of sugar beets from the beet Curculionidae, but also to prevent this pest from overwintering; to conduct a planned and large work in lowering their numbers and reduce the areas infected by it.

We also have large deficiencies in the work of protection from pests and diseases of other technical crops, and of cotton especially. During postwar years the control of pests and diseases of cotton was restrained considerably by the insufficiency of poison chemicals. During the past year this shortage was largely eliminated. Together with improvements in the supply of cotton planting regions with sulfur, which is as yet the basic means for control of the most dangerous pest of cotton, the cobweb mite, a high effectiveness in the protection of cotton plantings from this pest was shown by phosphorus organic preparations of systemic action, mercaptophos and octamethyl.

Yet, for the control of the many pests of cotton, and especially of cobweb mites, one cannot rely exclusively on the exterminating measures. It is very important to reestablish in many cotton growing regions as widely as possible the undeservedly forgotten practice of prophylactic measures, the spraying of weeds and of mulberry trees where the cobweb mite propagates during the early spring period, and from where it then moves on to cotton. This will not only increase the effectiveness of protection of cotton from the cobweb mite, but will also reduce the need of buying the expensive, and yet scarce, poison chemicals.

Many urgent actions must be taken for the protection of orchards, of vegetable crops and potatoes for the control of pests and diseases. One

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must point out that the most high losses in crops from pests and diseases of agricultural production are permitted in these branches. Leaf-roller moths are widespread almost everywhere, as well as scabs of apples and of other fruits, which bring an exceptionally great harm to horticulture.

Annually millions of centners of valuable production are lost as a consequence of inattentiveness of many kolkhoz and sovkhoz leaders to the protection from pests and diseases of vegetable and melon patch crops. During the last several years in the potato planting regions the late blight of potatoes became widespread, as well as many other serious potato diseases. All this requires a serious improvement in the protection of orchards, as well as of plantings of vegetable crops and of potatoes from diseases and pests.

The chemical industry at the present time is able to fully satisfy the demands for poison chemicals, which are needed for the effective protection of vegetable and potato crops and of orchards from a danger that threatens them. Thus, with a more attentive attitude, on the part of the leaders of farms, to the protection of plantings from pests and diseases, these large deficiencies can also be overcome to a great extent.

Quarantine measures are of great importance for the protection of the crop; they are directed for the protection of the country from the penetration from without of many very dangerous pests and diseases which are absent in our country, as well as in the localization and extermination of foci of the previously imported quarantine pests and diseases. A further spreading of such dangerous pests and diseases as San Jose scale, potato canker, and so on are very dangerous for agriculture. During the past year in Kaliningradsk regions were discovered foci of Colorado potato-beetle, whose penetration [Begin p.6] into the basic potato growing regions of the country can bring a very serious damage to agriculture.

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A comparatively small group of specialists in the Quarantine Service carries on in this field a very important work, underestimation of which can lead to very dangerous consequences. One must keep in mind that only during the past year in plant shipments which entered from other countries, and particularly in parcels with seeds, were found many cases of the presence in them of very dangerous pests and diseases; included in these were pink bollworm in samples of cotton seeds from USA and China; "chetyre-khpiatnistaia zernovka" [a four-spotted weevil, found in cereals] in seeds of chick-peas, that arrived from Turkey, Chinese weevil in seeds of soybeans, which were brought from Vietnam, Indian smut of wheat, smut of rice, and so on. Penetration of these pests, especially of the pink bollworm into our country can lead to huge losses. Control of the most dangerous quarantine pests and diseases must be accomplished first of all and by all possible means. At the same time, and as soon as possible, it is necessary to eliminate certain limitations in the quarantine rules which are superfluous, are not called for by any necessity, and which in many cases, without any need, complicate the activity of agricultural organizations.

The exclusive role in making decision belongs to scientific-research institutions; and problems for the protection of plants together with finding new, more, effective means and methods, they must give active help to those engaged in production in the most correct use of already known methods for the protection of the crop, as well as the most effective utilization of material-technical means. This is the main responsibility of the zonal scientific-research institutes and stations.

They must find the most effective methods and means for control of pests and diseases suitable to the conditions of the zone serviced by them also to work out and to arm the agricultural organizations, kolkhozes and

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sovkhozes with a system of measures for the protection of all the crops cultivated in this zone. This same work must be conducted by branch institutes according to the crops which they are servicing.

At the same time VIZR, together with the Republic institutes for plant protection, as well as the branch institutes with the attraction of the necessary Chairs of agricultural institutes and of special institutes of the Academy of Science of USSR and of allied Republics, must considerably increase the work of finding new more effective means and methods for control of pests and diseases of plants. In particular, it is necessary to intensify the research for means of control of the Eurygaster bug in places of its overwintering, to accelerate the tests of systemic preparations as, for instance, metasystox M-81, M-82 which have a smaller toxicity in respect to warmblooded animals compared to mercaptophos and octamethyl; to develop sufficiently effective and economic means for the control of mallow moths, of smut and rusts on plantings of grain crops, of the late blight and of canker of potatoes.

The existing methods for the control of the Colorado potato-beetle, of nematoda, of leaf-roller moths, of San Jose and other scales are excessively expensive and often insufficiently effective. It is proper also to draw attention to the extremely harmful underestimation, which exists in science and in practice, of the biological method for the control of pests. Meanwhile, it is quite obvious, that a successful realization of control of the harmful Eurygaster bug, of leaf-roller moths and many other pests, including also those of the forests, can be achieved when the chemical methods would not only be co-ordinated to, but also supplemented by the biological and biophysical ones.

It is necessary to widen, in every way possible, the scientific-research work of investigating the nature of resistance of plants to the pathogens of

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diseases and to harmful insects and to cultivate the varieties of plants resistant to them.

It is beyond doubt that great and complex problems, which loom before the agricultural production of our country in 1957 will be successfully solved, and all the specialists in the protection of plants will take an active part in it; all of them who work in kolkhozes, sovkhozes, MTS, in squads, administrations, scientific-research organizations and in schools of higher education.

V. V. Kosov.

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File in notebook

Poliakov, I. Ia.

Puti uluchshenia raboty slushby ucheta i prognozov.

[Means of improving the estimation and forecast service].

Zashchita Rastenii, no. 2. 1957. 421 Z1

(In Russian)

Prognosis of the appearance and development of plant pests and diseases is of great importance to the State in the planning, proper organization, and timely implementation of measures required for the protection of the yield. At the present time, however, the situation of the estimation and forecast service does not always meet the assigned tasks. The basic organizational shortcoming is the inadequate network of observation points. In some large agricultural districts of Siberia, and Kazakhstan and in a number of other regions of the country they are completely lacking. Scientific institutes, experimental stations, zonal and branch institutes are not invited to participate in the compilation of forecast data. A network of correspondents selected from local agronomists, whose knowledge of production conditions and production characteristics could be of great help, has not been organized. Nor has any use been made of the extensive network of State variety-test-plots which could furnish valuable information on the development of some types of pests and diseases.

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As a result of the above, the foci of pests are often discovered too late, the best time for control is allowed to slip by, and the measures carried out frequently fail to achieve the required results.

Aiming to improve the service of estimation and forecast of the appearance and development of pests and diseases, the Ministry of Agriculture, USSR, in December of last year, 1956 adopted a decision for the expansion of observation points and sectors and approved a new regulation for the plant disease and pest estimation and forecast service. Pursuant to this regulation, zonal and branch institutes, centers of the State variety network, and kolkhoz and MTS [Machine Tractor Stations] agronomists will be asked to participate in the compilation of disease and pest incidence data. The task now involves speedy coordination of the service in accordance with the new regulation.

Sectors of the Republics are required to set up concrete plans for the forecast of the appearance of the principal pests and diseases, and to determine which scientific and production establishments are to be enlisted in this work. Special attention must be paid to the compilation of scientifically justified, timely, short-term forecasts that provide for the greatest effectiveness of extermination measures.

Oblast (territorial) sectors and observation points must organize the selection and instruction of numerous correspondents and reestablish communications with zonal scientific institutes.

Plant protection departments of zonal institutes are called upon to provide guidance in methodology to sectors and observation points. In addition, they must generalize all material concerning pests and diseases

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throughout the zone and on this basis compile annual surveys and prognoses to be submitted to the ministries of agriculture of the Republics and to VIZR [All-Union Institute of Plant Protection] for the preparation of Union-wide and Republic-wide forecasts. Hence, the active participation in planning the work of sectors and observation points, and the rendering of methodological aid are important aspects in the activities of plant protection departments of zonal institutes.

The responsible task of forecasting is imposed also on branch institutes. Up to now, only the All-Union Scientific-Research Institute of Sugar Beets has accomplished this task adequately. [Begin p. 4]. Henceforth it will be done by all branch scientific-research institute. Plant protection departments of these institutes must coordinate their activities with the corresponding prognosis sectors and experimental stations which are able to furnish the required information. There is no doubt that having a wide-spread network of correspondents selected from the ranks of agronomists is in the best interest of the branch institutes. Apart from short-term prognoses, branch institutes are to compile yearly surveys and forecasts on pests and diseases of the crop being investigated and are to submit them every year to the Ministry of Agriculture USSR and to VIZR not later than December 15.

VIZR is charged with the methodological direction and compilation of disease and pest forecasts in the USSR. It is provided also that VIZR will supervise the work of branch and zonal institutes. The Methodology Guide for the estimation and forecast of the development of pests and diseases is now at the printers. Its publication will regulate the activities of the service considerably.

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An analysis of the surveys and long-term prognoses for the years 1954-1956, and operational accounts for 1955-1956 show that the disease and pest forecasting meets current demands more or less in some individual Republics (Ukrainian, Tadzhik, Azerbaidzhan), the Altai and Krasnodar Territories, and in the Saratov and Voronezh Oblasts. In most places, however, there are many shortcomings in this important affair.

First - inadequate scientific justification of a given prognosis. It is known that up to now, more or less developed methods of prognosis are available only for mouse-like rodents (though not for all regions of the USSR), acrididae, some types of butterflies, Eurygaster integriceps, the Hessian and Swedish flies, and some other pests. Science does not as yet have at its disposal the proper methods for individual plant pests and diseases. However, methods of determining their distribution and their quantity or intensiveness of development have been worked out for most pests and diseases. It is known also which ecological conditions can be considered as favorable, and which as unfavorable, but, for some reason, these factors usually are not considered in surveys and forecasts.

Second - incorrect choice of time for inspection and estimation. It is felt erroneously that fall inspection is conducive to obtaining the material required for surveys and prognosis of the appearance of all pests and diseases. It must be remembered that the same seasons in the same locality have a different ecological significance for different types of pests and diseases which is due to the difference in their environmental requirements. Besides, the time of inspection for each species must be selected with a view to its biological characteristics. One inspection must be carried out

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after an unfavorable season of the year when quantity and development are at a minimum, another - after the most favorable period, when the quantity and development of pests in the given year have reached their maximum. In cases in which the quantity of a species for the following year is determined by the quantity of wintering individuals (sugar-beet weevil, Eurygaster integriceps), of eggs (of locusts, aphids), cocoons, caterpillars (of butterflies), or larvae (wireworms), orientation must be based on their calculation in the fall and on control estimates made in the spring, which determine the mortality of pests during wintering. Consistent and systematic comparisons of data obtained after an unfavorable period with the quantity and distribution of pests on resources after a period which had been favorable for their reproduction, may produce more complete data for prediction. Unfortunately, there is no such analysis either in the surveys and prognoses, or in the operational accounts of the Republics.

Third - the inferior quality of inspection and estimation. To begin with, inspection is to define the types of resources (vegetation) and the terrain infested by pests and infected by diseases. Inspection of every inch of land is, of course, impossible. This circumstance makes it compulsory that the vegetation (terrain) infested or not infested by individual species be determined most carefully and the regularities of species distribution be established according to vegetation. For many pests (mouse-like rodents, susliks, wireworms, beet weevils) [Begin p.5]. and particularly diseases (potato wart and Phytophthora, etc.), accurate characteristics of the localities infested by them furnish all the information required for the prognosis of their development in the coming year. In inspections, it is important to consider not only the crop species and the preceeding crop, but

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also the variety and the sections of the relief [location] of a given resource on which pests have concentrated. Only material of this sort makes it possible to form an idea of the general distribution of pests and diseases. Within the boundaries of a specific region, ecological conditions on similar vegetation are identical by virtue of the similarity of climatic conditions and agrotechnical and economic measures. Hence, the laws of distribution and quantity of a given species of pests or the development of disease on vegetation and terrain established on inspected farms give a sufficiently sound idea of the situation on all farms of the region, even on those not inspected. Knowing the infection percentage of the area of individual types of vegation, and knowing the general area of this type of vegetation in the oblast (territory or separate zone), the infected area can be estimated accurately.

In practice, it usually is indicated in account books that: so many hectares have been inspected, so many of these are infected. This fails to give any idea of the true situation, since there is no indication as to which vegetation had been inspected and what area of these resources had been attacked by pests and diseases. As a result we now have no real idea as to what area in the country actually is infested by many important pests, even by those which persist in number (suslike, wireworms etc.).

Fourth - lack of analysis of the economic importance of plant protection. To be able to evaluate correctly the profits derived from any agrotechnical measure, one must know what increase it produces in yield and in the total income of the farm. To learn to know the economic effectiveness of plant protection, it is necessary to take into account the losses of yield caused by pests and diseases, the net cost of measures applied, and the results achieved. Such material is, unfortunately, lacking in the surveys and forecasts and in operational accounts.

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Yet it is not so very difficult to obtain such material. Agronomists usually appraise quite correctly yield losses incurred for different reasons. Methodology for the calculation of the effectiveness of extermination measures for most mass pests has also been developed. Nor is it hard to estimate the cost of material used. The accumulation of such data will permit utilizing resourcefully the hidden means of plant protection so as to increase the income from agricultural production.

Now, favorable conditions have been created for the elimination of flaws in compiling forecasts. It is necessary to arouse the interest of kolkhozes and to attract agronomists. Their assistance is especially important in carrying out inspections and in calculating the technical and economic effectiveness of plant protection measures.

The most immediate big problem is to identify accurately the areas infested by the most important mass pests - locustidae, beet weevils, susliks, and wireworms; areas infected by plant diseases the causal agents of which remain in the soil - Phytophthora, potato wart etc.

Available material justifies the assumption that in 1957 mouse-like rodents will spread extensively in Trans-Caucasus, that the damage caused by them will increase on the fields of Northern Kazakhstan, Western Siberia and in the Altai Territory; in the second half of the year, the number of field-voles and mice will increase in the Caucasus. Now, as heretofore, special attention must be paid to the control of Eurygaster integriceps, and in some places - to locusts, the cotton bollworm, cutworm moth and other pests.

In the appeal which the TsK KPSS [Central Committee of the Communist Party of the Soviet Union] and the Council of Ministers USSR, addressed to all workers of agriculture, it says - the task of increasing productivity

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must become the task of the whole nation and of every branch of the Government. In taking part in the competition in honor of the 40th anniversary of the Great October Socialist Revolution, the workers of plant protection and of the estimating and forecasting service must mobilize all their strength in order to organize exemplary control of pests and diseases and to prevent fully yield losses of all agricultural crops.

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Karasevich, Iu. N.

Soveshchanie po ispol'zovaniiu pentozansoderzhashchego syr'ia.

[Conference on the Use of Raw Material Containing Pentosan].

Mikrobiologiia; vol. 25, no. 6, pp.756-757
Nov.-Dec. 1956. 448.3 M582

(In Russian)

A Conference on the Use of Raw Material Containing Pentosan was held by the Scientific Council at the AN Latv. SSR [Academy of Sciences, Latvian SSR], in Riga (Latvian SSR), July 11-12, 1956. Reports devoted to the production of feedstuff yeasts from pentosan containing raw material were heard and discussed on July 12th.

In his introductory address, A. A. Imshenetskii pointed out the significance of this problem and the importance of wide-spread theoretical investigations required for its successful solution. He underscored, particularly, the prospects of theoretical investigations on the fermentative hydrolysis of wood and plant waste in agriculture.

P. N. Fisher, in his report "Prospects of the development of technology in the production of feedstuff yeasts from raw material containing pentosan" explained the technological process of continuous production of feedstuff yeasts which now are adopted by factories using waste liquor of wood hydrolysates and sulfite lye. The reporter dwelled in detail on the prospects of improving the technology of this process, emphasizing that the principle task involves considerable simplification of the individual opera-

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tions of the technological process, its automatisation and adaptation to the production of highly efficient technically progressive equipment. Having eliminated the operation of preparing the waste liquor of sulfite-alcohol and hydrolysis factories, the simplification of the technological process can be achieved by combining the separate phases of this operation with the general preparation of sulfite lye an hydrolysate for the production of alcohol.

To achieve maximum efficiency of available equipment, yeasts must be grown on culture media containing 4-5% of sugar (or, if hydrolysate liquor is used for growing, then its sugar content must be increased up to 0.8--0.9% since wood hydrolysate had been added), while increasing simultaneously intensity of aeration of this medium with the aid of mechanical mixing and the use of oxygen mixed with air for aeration. It is necessary also to develop more effective methods for the separation of yeasts from the medium and for their drying.

Apart from feedstuff yeasts, raw material containing pentosan can be utilized in the production of concentrated feed that contains carbohydrates, protein, vitamins and antibiotics. This calls for the use of sugar of water prehydrolysates of pentosan containing raw material for the cultivation of yeasts, for synthesis of protein and other microorganisms [and] for the synthesis of vitamins and antibiotics. Concentrated water prehydrolysate with the products accumulated within it comprises concentrated feedstuff.

Available stocks of pentosan-containing raw material utilized efficiently would help to increase within the next few years the production capacity of feed yeasts up to 200 thousand tons per year.

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In his report "Adapting yeasts to arabinose", A. A. Imshenetskii told about the work done by Iu. N. Karasevich in adapting Candida and Torula to arabinose at the Institute of Microbiology, AN SSSR [Academy of Sciences USSR].

The work shows that the yeast Candida tropicalis is readily adapted to arabinose. The process proceeds as a typical enzymatic adaptation. Culture of Candida in autolysates prepared from yeasts capable of growing on arabinose fails to accelerate adaptation. Up to now, adaptation of Torula utilis to arabinose has not been successful.

A. P. Kriuchkova's report "Feed yeasts as a source of protein and vitamins" contained data on the synthesis of aminoacids and vitamins by feed yeasts. In feed yeasts of hydrolytic and sulfite-alcohol factories the following vitamins were found: thiamin, riboflavin, pantothenic acid, biotin, niacin, folic acid, pyridoxine and inosite. In some cultures vitamin B_{12} was found. Yeasts grown at the Krasnoiarsk factory have the most vitamins. Feed yeasts include ergosterin. Exposure of the water extraction of such yeasts to ultraviolet rays makes it possible to obtain yeasts enriched with vitamin D_2. The protein of feed yeasts includes all vitally necessary aminoacids: histidine, arginine, lysine, leucine, isoleucine, valine, methionine, threonine, phenylalanine, tryptophan, alanine, proline and others. Feed yeasts are a valuable protein feedstuff. They are qualitatively as good as baker-yeasts and as good as feedstuffs of animal origin: fish and meat-bone meal. Their methionine and vitamin B_{12} content, however, is insufficient. Hence, in the further selection of yeasts, a search must be made not only for more productive races, but also for more active producers of vitamins and aminoacids. Enrichment of yeasts with vitamins can be achieved by cultivating them together with micro-

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organisms that synthesise a large quantity of vitamins. [Begin p.757].

A. V. Modianov read a report dealing with the use of feed-yeasts in animal husbandry, poultry raising and in raising semi-wild beasts. Emphasizing that the present production of feed yeasts is entirely inadequate, the reporter pointed out that the demand for this irreplacable feedstuff is so great that many poultry farms and wild beast farms are forced to manufacture home-made feed yeasts. It is necessary to increase considerably the production of feed yeasts at the earliest possible date.

E. A. Plevako, in his report "News in yeast production abroad", dealt with the general development in the production of feed-yeasts on diverse substrata, including media that contain pentose. In a number of foreign countries new factories have emerged that produce feed-yeasts on cane molasses or on the waste liquor of molasses-alcohol manufacturing plants. The successful development of technological production schemes has made a reduction of the net cost of yeasts possible. Abroad, much attention is paid to the utilization of residual yeasts of alcohol and beer production. A series of products are developed from the yeasts obtained for food and feed purposes: autolysates, plasmolysates, and hydrolysates.

The report "Development of the production of feedstuff protein yeasts from pentosan-containing raw material in the sixth five-year plan and the plan of scientific investigation work" was submitted by S. V. Chepilo. He pointed out that specific capital investments per unit capacity in yeast production at hydrolytic factories remain relatively high. At present, this factor determines to a considerable degree the rate of the development of yeast production in the hydrolytic industry. Hence, the development of yeast production in the sixth five-year plan is based chiefly on the

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reprocessing of waste liquor at sulfite-alcohol factories. While the hydrolytic industry plans to produce 9,100 tons of yeast by 1960, the production of yeast by the sulfite-alcohol industry, by 1960, is to increase up to 20,750 tons. For the further expansion of the production of feed yeasts, it is necessary, concomitantly with the utilization of malt at sulfite-alcohol and hydrolytic factories, to draft plans for the construction of hydrolytic-yeast factories based on the reprocessing of plant waste of agriculture and of a number of other specialized factories. It is extremely necessary to decrease unit capital investments and to reduce the net cost of yeasts. To achieve this the technology of yeast production must be improved and, to begin with, a simple and inexpensive method must be used in the hydrolysis of polysaccharides. For instance, the continuous method of hydrolysis of plant tissues with concentrated acids, particularly hydrochloric acids offers real possibilities of decreasing the construction cost of hydrolytic-yeast factories and of reducing the net cost of yeasts.

The special section of the report was devoted to problems of scientific-research work. The reporter stressed the need of research work for the purpose of developing a continuous method of hydrolysis of plant waste of agriculture and of the wood of shade trees (listvennykh porod] with concentrated acids, selection of productive yeast and fungi races, increasing the vitamin content in feed yeasts and improving their quality, and production of fatty and baker yeasts from raw material not for human consumption.

After a discussion of the reports submitted, the delegates adopted a resolution approving of the basic principles contained in the reports and pointing out the need in the USSR for a speedy development of the production of feed-yeasts on pentosan-containing raw material.

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Gar, K. A., Mel'nikov, N. N., Mandel'baum, Ia. A., Chernetsova, V. I., and Shvetsova-Shilovskaia, K. D.

Primenenie metoda mechenykh atomov k izucheniiu stabil'nosti dustov fosfororganicheskikh insektisidov.

[Use of tagged atom method in study of the stability of dusts of phosphorus-organic insecticides].

Akad. Nauk SSSR. Dok. vol. 94, no. 4. pp.729-732. Feb. 1, 1954. 511 P444A

(In Russian)

(Submitted by Academician S. Ia. Vol'fkovich, Nov. 30, 1953)

Phosphorus-organic insecticides and, particularly, diethyl-4-nitrophenylthiophosphate - the active basis [deistvuiushchee nachalo] of the NIUIF-100 preparation (thiophos) - are highly effective preparations for the control of different types of pests of agricultural crops. It is characteristic of these preparations to rapidly lose their toxic effect upon pests.

The given work examines the problem of the influence of external factors upon the stability of the toxic properties of diethyl-4-nitrophenylthiophosphate dusts which is of great practical importance, since this influence determines the time when treatments should be repeated. Knowing what amount of the preparation remains on the plants on different dates following the treatment is important also from the standpoint of safety in using the treated plants for food. The solution of this problem by the straight chemical method of analysis involves considerable difficulties. According to P. V. Popov's (1) data, a 1% NIUIF-100 dust stored in a thin layer in the laboratory loses about 60% of its toxicity during

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the first day [24 hrs] and retains 17% of toxicity for 30 days. The author's observations indicate that in spraying 1% dust from an airplane under conditions of the Krasnodar Territory, the dust dispersed loses its toxicity against Eurygaster integriceps almost completely within one day.

For a study of this problem, Ia. A. Mandel'baum and K. D. Shvetsova-Shilovskaia, under the supervision of N. N. Mel'nikov, have prepared two phosphorus-organic insecticides tagged with the aid of the radioisotope of phosphorus P^{32} (in several experiments synthesis of insecticides tagged with S^{35} was accomplished).

A comprehensive study was made of diethyl-4-nitrophenylthiophosphate (d_4^{20} 1.2704, n_D^{20} 1.5374, t. pl. /melting point/ 6°, t. kip. /boiling point/ 115-117°/0.05 mm rt. st. /mercury column/ and ethyl-4-dinitrodiphenylthiophosphate (crystal line product with a melting point of 125°). During the synthesis of the compounds indicated, a series of intermediate compounds tagged with phosphorus and sulfur were obtained. A further study of the compounds indicated was accomplished at the toxicological laboratory.

For a study of the influence of temperature, 1% dusts of the other compounds under investigation were sprayed on small glass cups (measuring d = 15 mm, h = 8 mm, ground down at the edges) covering the surface at the rate of about 0.1 mg/cm^2 of dust. The cups were placed in dark incubators at temperatures of 16, 25 and 45° [C]. The remainder of the preparation was measured out periodically for intensity of radiation and a correction was made for decomposition. [Begin p.730].

As a result, data were obtained concerning the quantity of insecticide or of the non-volatile products of its decomposition containing phosphorus. A decrease in the amount of phosphorus (taking into account decomposition) could be attributed in this case solely to the evaporation of the compounds

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under study or of the products of their decomposition.

Fig. 1 shows that loss of phosphorus from 1% diethyl-4-nitrophenyl-thiophosphate dust (preparation NIUIF-100) occurs considerably quicker than from 1% dust of ethyl-4, 4'-dinitrodiphenylthiophosphate. Under conditions of continued storage for 100 hours at a 45° temperature, half of the dust of the NIUIF-100 preparation is lost, yet the dust of ethyl-4, 4'-dinitrodiphenylthiophosphate takes 650 hours before half of it is lost. At a lower temperature both compounds last considerably longer.

The data obtained permit drawing the conclusion that the discontinuance of the toxic action of 1% dust of the NIUIF-100 preparation under field conditions within 1-2 days after the spraying cannot be explained solely by the evaporation of the active portion [deistvuiushchee nachalo].

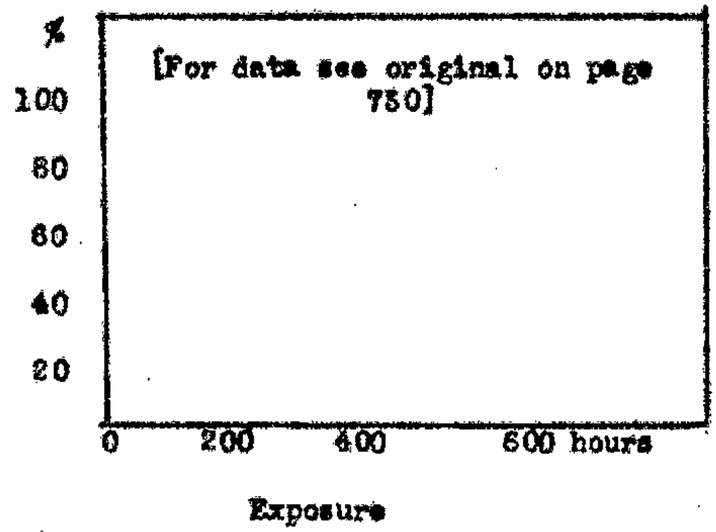

Fig. 1. Rate of loss of phosphorus from dust when sprayed in a thin layer at various temperatures. 1 - 1% dust of NIUIF-100; 2 - 1% dust of ethyl-4,4'-dinitrodiphenylthiophosphate.

This is obvious, particularly, from the results of the experiment in which the glass cups (d = 30 mm) had been sprayed with 1% dust of the

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NIUIF-100 preparation (at the rate of about 7 kg/ha). Some of the cups were stored in the laboratory, some were placed under the quartz lamp PRK-4 at a distance of 25 cm from the lamp for 1.5 and 3 hours, and a part of the cups intended for the control of heat action, exposed to light of quartz lamp, were placed in an air incubator at a temperature of about 40° (the 40° temperature was taken because gauging the temperature of dusts under the quartz lamp showed that that they can be heated up to this temperature).

Table 1.

Results of change in the toxicity of 1% dust of the NIUIF-100 preparation when stored under different conditions

Mortality of weevils on the 2nd day after dusting in %			
Initial dust	Dust stored in an air thermostat at 40°	Dust exposed to light of quartz lamp for period of 1.5 hrs	Dust exposed to light of quartz lamp for period of 3 hrs
43	17	12	2

After the exposure, beetles of the granary weevil (Calandra granaria L.) and wheat grains were placed in the cups. Two days later a count was taken of the dead beetles which served as an indicator of the loss of toxicity of dusts under different conditions.

In connection with the above, establishing the causes of the loss of toxicity was of great interest.

In the following series of experiments the loss of phosphorus from 1% dust of the NIUIF-100 preparation and from 3% dust of ethyl-4,4'-dinitrodiphenylthiophosphate was gauged during the exposure of thinly dispersed

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dust to solar rays. Testing methodology was the same as that used before. The open cups were exposed to light. The experiment was conducted in two variations - exposure to direct solar rays and exposure to diffused sun light (in the shade). It must be noted that the cups containing the dust which were exposed to direct solar light were, in part, heated by solar rays, [Begin p.731] but the surface temperature under conditions of direct solar light did not exceed 37°. In the shade the temperature of dusts was the same as the temperature of the air (26-30 VII), the average daily temperature was at this time [of year] 17° [C], i.e. experimental conditions approached conditions prevalent when dust was used in the control of plant pests in nature.

In fig 2 data are cited on the loss of phosphorus from dusts. It must be noted that the first 3 hours of exposure were sunny, then the sun was shining between the 22nd and the 28th hours of exposure. The rest of the time the cups were exposed to diffused light.

It is obvious from fig. 2 that the loss of phosphorus from 1% dust of the NIUIF-100 preparation occurs very rapidly in direct sun light - 50% of the preparation was lost in approximately 1.5 hours. The other 50% was lost almost completely within 100 hours; during this time the cups were exposed to direct solar rays altogether 6 hours, the rest of the time was divided between exposure to diffused light and night time. Whenever the cups were exposed to diffused light only, the loss of phosphorus from the NIUIF-100 preparation occurred more slowly - about 50% of the preparation was lost within 20 hours and about 80% of it within 100 hours. Corresponding experiments have shown that phosphorus from the residue left on plants sprayed with emulsions from a 30% concentration of the NIUIF-100 preparation is lost at approximately the same rate.

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Loss of phosphorus from dust of ethyl-4,4'-dinitrodiphenylthiophosphate occurs considerably slower - in an open area exposed to sunlight, about 40% of phosphorus vanished within 70 hours. Under conditions of diffused light about 20% of the preparation was lost during an exposure of 72 hours.

The figures cited compared with data obtained in the earlier series of experiments indicate that exposure of the dusts derived from the preparations NIUIF-100 and ethyl-4,4'-dinitrodiphenylthiophosphate increases sharply the loss of their phosphorus. The loss of phosphorus from these dusts under conditions of solar radiation is a complex photochemical process.

The data obtained explain the cause of the rapid loss of the toxic effect of dust prepared from the NIUIF-100 preparation when it is sprayed under natural conditions that expose it to direct solar rays.

It is interesting to estimate the possible residue of the NIUIF-100 preparation on fruit when its dust has been used to treat fruit plantings at the rate of up to 30 kg/ha (or 1000 liters of 0.1% emulsion from a 30% concentrate which comprises about 3 gm of dust per m^2 of soil surface, or 0.03 gm of the effective element per m^2). Considering that the surface of leaves is only 5 times larger than the surface of the soil (usually the surface of leaves exceeds the surface of soil 5-10 times), it can be assumed that 4 days after the dust had been sprayed and had been fully shaded against direct solar rays, the NIUIF-100 preparation left on 1 m^2 of leaf surface comprises less than 0.002 gm. [Begin p.732].

On the basis of these figures we shall estimate the residue of the preparation also on the fruit. If it were assumed that the total surface of 1 kg of fruit (apples) comprises about 0.12 of a m^2, then the maximum residue of the NIUIF-100 preparation on 1 kg of fruit found in the shade will

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comprise less than 0.25 mg four days after the treatment. In practice, the residue of dust on the fruit will always be 3-4 times less than this figure, since losses amount to no less than 75%.

It follows from the above, that even under very "mild" conditions, the residue of the NIUIF-100 preparation on plant leaves and fruit, four days after the treatment, will not exceed 0.25 mg per kg of fruit, which is 8 times less than the safe rate for residues of thiophos preparations established abroad (2).

Under conditions of even partial solar radiation, the amount of the residue indicated will be less one day after the treatment.

Nauchnyi Institut Udobrenii
i Insektofungisidov

[Scientific Institute of Fertilizers
and Insectofungicides].

Received Oct. 29, 1953

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Vasil'ev, V. P. and Petrukha, O. O.

Meropriiatiia po bor'be so sveklo-
vichnym dolgonosikom.

[Measures for the control of the
beet weevil.]

Zashchita Rastenii ot Vreditelei i
Boleznei; vol. 2. no. 2. pp.38-41
Mar.-Apr. 1957 421 21

(In Russian)

Pursuant to Directives of the 20th Congress of the Communist Party of the Soviet Union, the sugarbeet crop by 1960 must be increased by 54%. This makes control of the common beet weevil [Bothynoderes punctiventris Germ.] necessary. Efforts are made to exterminate 80-90% of these weevils in their hibernation places. Often only 20-50% of the beetles are destroyed, the rest infest beet plantations. Any delay in digging trenches for their destruction leads to undesirable results. The beetles which have accumulated in the top soil layer (50-60% of their total number) can within 2-3 days leave the beets and enter field crops.

Beetles of the beet weevil, having developed in the soil, may remain there for 2 to 3 years. Frequently fields seeded to beets two years ago are not treated and the beetles emerge from the soil and invade the sugar beet crop. Treatments must be simplified to reduce labor consumption and operations must be organized. The shortcomings of the KF-30 trench-digger, in use for the past 5-6 years, can be eliminated. The machine digs 20 km of trenches per working day relieving 400 men.

The VNIS [All-Union Scientific-Research Institute of Beets] has

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constructed the new KNK-15 tractor-mounted trench layer which permits mechanizing the laying of trenches. Wells should be drilled in trenches as they are layed. It must be noted that neither the scientific-research institutes of mechanization of agriculture, the appropriated Administrative Agencies of the Ministry of Agriculture of the Ukrainian SSR, nor the Ministry of Agriculture of the USSR have paid sufficient attention to this important matter.

Trenches and wells used in combination with benzene hexachloride and other poisonous chemicals comprise at present the basic control of beet weevils on old beet fields. Experiments conducted by the All-Union Scientific-Research Institute of Beets in 1955-1956 [Begin p.39] have established that 70-80% of beetles can be destroyed after they have emerged from the soil. Experiments of VNIS and the UNIZR [Ukrainian Scientific-Research Institute of Plant Protection] have shown that development of beetles can be prevented even now by using poisonous chemicals before egg-laying and the phase of larvae begin in the soil. The effect of barium chloride, fluorine compounds, paris green, arsenic preparations etc. depends on weather conditions. Under favorable weather conditions the death of weevils caused by the above chemicals does not exceed 85-90%. The effect of these chemicals is of short duration and complete destruction of beetles and prevention of egg-laying cannot be achieved.

The use of chloro-organic insecticides changes the situation. DDT and benzene hexachloride, chlorinated terpenes (chlorotenes, polychloro-pinene, polychlorocanphene) are preparations obtained by chlorinating the products of diene synthesis (chlorindan, heptachloride, aldrine, dildrine) which make it possible to discontinue the use of stomach insecticides as lacking in effectiveness.

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Under unstable weather conditions, decreased amounts of DDT, chlorotene or polychloropinene destroy the beetles of weevils close to 100%. In experiments conducted by VNIS and UNIZR in 1956 with the above chemicals, the number of beetles of the new generation did not exceed 0.5 per square m.

The cost of barium chloride used in five-replicate treatments was 45 rubles per ha when sprayed by aircraft and 72 rub. in surface spraying, while DDT paste used in two treatments cost 19 rubles and 20 kopeks, DDT emulsion - 30 rub., benzene hexachloride [GKhTsG] emulsion - 25 rub., and emulsion of polychloropinene 28 rub. [Begin p.40]. The availability of concentrated working emulsions will increase the efficiency of labor.

Experiments conducted in 1955-1956 on the imeni Stalin kolkhoz, Starchenkov District, Kiev Oblast, have shown that DDT emulsion, DDT paste and polychloropinene applied with the aid of the ONK and ONK-100 tractor [mounted] sprayers with booms and equipped with nozzles permit to increase the concentration of the chemicals and to reduce the consumption rate of liquid per unit area. Consumption rate per ha remains unaltered.

Table.

Name and dose of poisonous chemical	Spraying date	Rate of solution used (l/ha)	Concentration of chemical (%)	Destruction of beetles (%)
Experiments of 1955				
Emulsion of DDT 6 kg per ha.	May 18	400	1.5	93.1
Same	" "	270	2.25	99.1
"	" "	135	4.5	93.4
Chlorotene 1.6 kg/ha.	May 21	400	0.4	97.4
Same	" "	270	0.6	86.4
"	" "	135	1.2	94.8
Experiments of 1956				
Paste of DDT 2.4 kg/ha.	May 24	135	1.8	93.1
Polychloropinene 1.6 kg/ha	June 1	135	1.2	100.1

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In 1956, consumption of concentrated emulsions was 155 liters per ha. Daily efficiency rate of sprayers was: ONK - up to 40 ha, ONK-100 up to 120 ha, and OKS with field boom - up to 70 ha. Funds saved in 1956 at 3.5 replicate treatment of 275 ha amounted to 5440 rubles.

A new method developed by UNIZR is the preseeding treatment of seed. In 1957 tests will be made of aerosol treatments of seed with gamma-isomer enriched benzene hexachloride solutions. The All-Union Scientific-Research Institute for Beets has developed two methods of applying benzene hexachloride to soil against larvae: the continuous method under preseeding cultivation at the rate of 40-50 kg of 25% benzene hexachloride on phosphorite meal per ha, and row application of benzene hexachloride mixed with fertilizers at the time of planting at the rate of 6 kg of a 25% solution per ha. Both methods can be used in the control of other pests as well.

Application of benzene hexachloride to sugar beets does not affect their quality or the biological processes in the soil.

Kiev.

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Trans. A-838
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Churakov, A. M. and Tagirova, B. F.

Aerozoli v bor'be so steblevym motyl'kom.

[Aerosols in the control of the European cornborer].

Zashchita Rastenii ot Vreditelei i Boleznei, vol. 2, no. 2, pp.35-36. Mar.-Apr. 1957 421 Z1

(In Russian)

The Moscow station of VIZR [All-Union Institute of Plant Protection] tested in 1955 aerosols against butterflies of the European cornborer [Pyrausta nubilalis Hb] on maize crops of the "Krasnyi Partizan" Kolkhoz and on the training farm of the Agricultural Technicum in the Slaviansk District, Krasnodar Territory.

It is known that the European cornborer produces two generations per season in this zone. According to our observations, the flight of first generation butter-flies and oviposition began during the first ten days of June, when maize sprouts had 3--4 regular leaves. It was noted that the flight of the butterflies was of mild intensity. The life span of butterflies of this generation was 7--10 days. June temperature was moderate (20.5°) and precipitation did not exceed 50.7 mm. The maximum amount of oviposition registered between June 24 and June 30 was 26-29 per 100 plants.

In the second generation the flight of butterflies and egg-laying proceeded more intensively which was due to the continued warm weather in July. Mass egg-laying lasted 16 days (10th to 25th of August).

The development of caterpillars of the second generation continued 25-30 days, and of cocoons 8-12 days.

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In the first generation, at the close of its development, ovipositions were discovered that were from 47 to 100% infested by Trichogramma - in the second generation, during the period of mass development, infection was 79.2--85.3%.

Aerosol treatment of the plot was carried out with the AG-L6 generator at gas temperature of 460° [C], rate of fog formation - 3.6 liters of the working liquid per minute. Rate of automobile movement did not exceed 5 km per hour. The width of the working range varied within the limits of 170-200 m. Consumption of the working liquid - 8% solution of technical DDT in Diesel fuel - was 6--8 liters per ha. Work was begun when darkness set in, at a 2--4 m/second wind velocity and air temperature of 10--22°. The maximum flight of butterflies was observed from 10 P.M. until 2 A.M.

The first treatment of crops with aerosols against butterflies of the first generation was conducted when 5--7% of the butterflies had flown out, the second - at the beginning of tassel flowering. The first treatment against the second generation was conducted on the 9th and 11th of August - at the milk stage of maize that coincides with the flight of 60% of the butterflies. At this time there were 10 to 24 ovipositions per 100 plants and 30-50% of these were infested by Trichogramma.

The second treatment against the second generation was begun 5 days after the first one. By this time the total number of ovipositions (on 100 plants) fluctuated, according to variants, between 26 and 36, and 60--70% of them were infested by Trichogramma.

Estimates made the first three days after each treatment with aerosols indicated that the number of ovipositions had decreased sharply. But later they proceeded to grow numerically, accompanied simultaneously by increased infestation of the eggs by Trichogramma (in the second generation).

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The general estimate of the number of ovipositions, including those infested by Trichogramma, indicated that, regardless of the time and frequency [kratnost'] of night treatments of crops with aerosols, the number of ovipositions infested by Trichogramma failed to decrease. Meanwhile, it was observed that the number of first generation caterpillars infested by parasites had decreased drastically. Caterpillars that had perished on untreated plots numbered 34%, yet on treated plots only 16.

Thus, aerosols in the form of an artificial fog created by AG-L6 from an 8% solution of technical DDT in Diesel fuel at the consumption rate of 6 liters of solution per hectare, can be used successfully in the control of butterflies of the European cornborer on maize and other crops injured by these pests, yet the use of aerosols against second generation butterflies is inexpedient in instances in which energetic Trichogramma activity insuring a high percentage of infestation of the ovipositions of the pest is observed.

In aerosol treatments of maize it was observed that other types of pests had also been exterminated - the citrus butterfly [limonnaia ognevka], and bindweed and cleavers [podmarinnik] cutworm moths.

From the Editor

The aerosol method has up to now not been applied extensively to the control of field crop pests, since industry has not as yet arranged for mass production of the AG-L6 apparatus. Hence, it is necessary in the coming year to utilize also other available methods in the extermination of the European cornborer in the regions of its distribution.

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It is known that this pest spends the winter in its caterpillar phase in the stems and stalks of maize ears, in the stems of millet and hemp, and in thick-stemmed weeds.

In the spring, when steady, mid-day air temperatures of 15-18° C set in, the overwintered caterpillars take on the form of a chrysalis. Before the caterpillar takes this form, it gnaws on the stem on the internal side making a round opening through which the butterfly that has developed from the pupa flies out 10-25 days later (approximately in May or early June).

Taking into consideration this biological characteristic of the pest, an effective control measure would be its extermination in early spring or complete utilization of the stalks of mowed down maize ears and other plants, in which caterpillars hibernate until warm days set in, for farm needs on kolkhozes and sovkhozes.

Apart from this, all stubble remains gathered during harrowing of fields in which maize had been grown in the preceding year must be burned in the spring.

Destruction of caterpillars in the spring before they turn into chrysalises will prevent or decrease considerably the appearance of butterflies, their egg-laying and subsequent development of caterpillars which severely injure maize.

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Trans. A-839
(Abstract)
vg/A

A
839

Khramtsov, G. P.

Novyi navesnoi opryskivatel' ONK-100.

[New mounted ONK-100 sprayer].

Zashchita Rastenii ot Vreditelei i
Boleznei, vol. 2, no. 2. pp.20-21.
Mar.-Apr. 1957. 421 Z1

(In Russian)

The ONK-100 sprayer was designed for pest and disease control in fields and orchards. It is mounted on the KDP-35 tractor and all of its mechanisms are set in motion by power drawn from the tractor.

It is equipped with a plunger pump that works at the rate of 130 l/min. Its reservoirs of a 950 liter capacity are mounted at the sides of the tractor. The reservoirs are equipped with blade mixers and are covered on the inside with an anticorrosive. They are connected with each other by rods. This sprayer is mounted more easily than other types and calls for no changes in the tractor. A two-sectional boom made of steel pipes is used in treating field crops; for orchard crops two wide-range nozzles that direct the upward flow are added. Work with the boom requires two workers, work with nozzles - three workers. Efficiency rate of the sprayer is 12 ha per hour or 80 ha per work day. It weighs 640 kg. In farm tests on the imeni Stalin kolkhoz, Starchenkov District, Kiev Oblast, the sprayer treated 230 ha of sugar beets. Tests have shown that the machine is simple, dependable, economical and convenient to work with. The Ukrainian MIS [Machine Testing Station] has determined that the sprayer's coefficient of exploitation dependability comprises 0.96,

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and the net cost of spraying is 7 rub. 78 kop. per ha.

The Ukrainian MIS has recommended the machine for serial release. An illustration of the ONK-100 at work is found on p. 21, and a general view of it on p.18.

Leningrad.

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A-840
(In full)
VG/A

Levykin, N. G. and Kosnikov, N. I.

O nedostatkakh opryskivatelei.

[Shortcomings of sprayers].

Zashchita Rastenii ot Vreditelei i
Boleznei; vol. 2. no. 2. pp.22.
Mar.-Apr. 1957 421 Z1

(In Russian)

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840

For several years, the Kuban Scientific-Research Institute for the Testing of Tractors and Agricultural Machinery checked the production models of the duster-sprayer ONK and the sprayer OIT. The first is mounted on the KhTZ-7 tractor and the second on the KD-35 tractor. The tests disclosed serious shortcomings in the sprayer ONK. Due to low pressure and inefficiency of the pump, the machine cannot be used to treat the crowns of trees over 4 meters tall, which renders it undesirable for older orchards. The work of two hose operators is rather hard: they must walk in shifts in a plowed interrow about 16-17 km carrying on their outstretched hands the spray gun [brandspoit] with the hose weighing no less than 10 kg.

The efficiency of the ONK was low for vineyard spraying because it treats only one side of the vineyard in one operation. No provisions were made for the protection of workers against poisonous chemicals. One of the serious shortcomings of the sprayer is the frequent choking up of the atomizers. Thus, in 70 cases out of 85 standstills were due to choked up atomizers.

The ONK sprayer-duster is more adequate for treatment of field and

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vegetable crops. It must, however, be noted that its bunker and tank capacity is low, making frequent refilling necessary.

The OLT sprayer proved to be a more efficient and economical machine in treating vineyards. It treats 4 rows of grapevine in one operation. Yet this sprayer, similar to the ONK, is not without considerable shortcomings. One of them is insufficient penetration of the liquid inside the shrub and poor coverage by poisonous chemicals of the lower side of the leaves at the surface of the crown as well as inside of it. Low pressure and low efficiency of the pump of the OLT sprayer prohibits treatment of trees over 4--5 meters.

In treating orchards with this machine, as well as with the ONK sprayer, the hose operators must follow the tractor which moves at the rate of 4.65 km per hour.

The construction of the cabin fails to provide protection for the tractorist working in vineyards against poisonous chemicals, and the tractor caterpillars which have no enclosures injure the grapevine. The real shortcoming of the OLT sprayer is failure of centering of the driven shaft of the transmission mechanism with the shaft drawing power from the tractor which causes a systematic breakage of bolts and breaking of the flexible coupling.

Considering the results of the sprayer testing, it must be noted that successful control of pests of field and vegetable crops, of orchards and vineyards calls for universal, highly efficient machines with powerful pumps. The capacity of the tank must be increased 2--3 times so as to reduce stand-

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stills of the machine for refilling to a minimum. Special attention should be paid to the improving of the working conditions of servicing personnel.

Krasnodar Territory

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Trans. A-841
(Abstract)
vg/A

Lukashevich, A. I.

Opyt termicheskogo obezzara-
zhivaniia semian.

[Experience in thermal seed disinfection].

Zashchita Rastenii ot Vreditelei i
Boleznei, vol. 2. no. 2. p.28.
Mar.-Apr. 1957. 421 Z1

(In Russian)

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841

To eliminate smut on wheat and barley on the "Kommunar" kolkhozes imeni Shevchenko and imeni Lenin where 8-9.5% of the barley crop was infected in 1953, chemical disinfection by the ineffective two-phase thermal method was discontinued in favor of the one-phase thermal method developed by the All-Union Scientific-Research Institute of Maize. In 1954, smut infection on the imeni Stalin Kolkhoz was reduced from 5.4% to 0.3. In a few years time the method was adopted by 5 seed growing associations. Smut had vanished on the Kolkhozes imeni Lenin, Shevchenko and Stalin. On two other kolkhozes infection was not over 0.9 in 1955 and 0.24 in 1956.

This simple method consists of heating seed in hot water and subsequent drying. The fodder steam-chest ZKP-1 can be used as a source of steam to heat the water. The grain is heated in water in wooden or iron boxes or in carting boxes without a container [bestarki]. Grain is placed in the water in sacks. Temperature is checked with a thermometer placed in the sack. Heating should last 3 hours at a 45° temperature or two hours at 47°. Then the seed is dried and can, as a rule, be seeded after 24 hours.

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Performance of one box is 12-15 centners within 10 hours, attended by 3 workers. A 2-box installation calls for 4 workers. Thermal disinfection was supervised by agronomists trained for plant protection. Seed plots for treated seed were allocated at a distance of 300-500 meters from general crops. To prevent increased smut infection, seed grain must be treated annually. To eliminate smut, this measure must not be limited to district seed kolkhozes, but must be carried out by every MTS on the kolkhozes which it services.

Dnepropetrovsk Oblast

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Isaev, S. I., Tarnovich, N. K. and Starostin, S. P.

Prisposoblenie k kombainu "Stalinets-6" dlia protravlivaniia semian.

[Device for seed disinfection attached to "Stalinets-6" combine].

Zashchita Rastenii ot Vreditelei i Boleznei, vol. 2, no. 2. pp.18-20, March-April, 1957. 421 Z1

(In Russian)

A 842

The machines and apparatuses, PU-1.0 and PSP-0.5 released currently by industry for the disinfection of seed material fail to meet the requirements of large grain kolkhozes and sovkhozes. It must be a highly efficient machine that will permit centralizing disinfection of seed grain and mechanizing all accompanying operations. The device for the "Stalinets-6" combine developed in 1955-1956 was designed for dry disinfection of seed against causal agents of diseases and for dusting against pests that inhabit the soil. It is of simple construction, convenient to work with, and it can be made in an MTS [Machine-Tractor-Station] workshop of the sovkhoz.

The working principle of the device is as follows: the grain, with the aid of a loader the performance of which is 50 tons per hour, is transferred to the grain bunker of the combine, from there it goes into the jacket of the unloading conveyer where it is disinfected with dust-like poisonous chemicals. For the purpose of intermixing grain with poisonous chemicals to better advantage, there are arranged small T-shaped shovels between the coils of the unloading conveyer of the combine.

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[Begin p. 19]. The disinfectant flows

Fig. 1. Schemes for feeding into device for disinfection.

[See original on page 18]

through a connecting pipe from a 25 dm^3 capacity fungicide bunker arranged on the unloading conveyer into the internal cavity of the coat of the unloading conveyer. The treated seed flows from the unloading combine pipe into the vertical canvas sleeve which ends in a funnel, and further into bags or onto the bed of a truck (without a container).

The kinematic scheme (fig. 1) of the device: from the pulley of the combine motor, motion is transmitted by a belt to the pulley of the drum and to the star wheel [svezdochka] on its shaft on the right side; further, with a chain, to the star wheel on the shaft of the first beater; from here motion is transmitted to the star wheel on the shaft of the beater of the receiving chamber and to the star wheel on the header [kheder] shaft; further - to the shaft of the unloading conveyer.

Transmission to the grain loader is accomplished as follows: with the chain of the star wheel on the header shaft - to the star wheel on the end of the projecting shaft of the reducer of the conic transfer of the header, and further with the chain from the star wheel on the protruding end of the second gear box shaft - to the star wheel on the shaft of the intermediate transmission of the grain loader (at this point, the pulley established on the transmission shaft is taken off). Motion from the pulley on the transmission shaft to the pulley on the shaft of the cap [golovka] of the grain-loader conveyer is transmitted by a wedge-shaped belt.

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The gear box of the conic header transmission is arranged on a frame on the right side of the combine.

Transmission to the measuring out mechanism of the fungicide bunker is accomplished as follows: the star wheel Z = 12 is established on the elongated projecting end of the unloading shaft of the combine conveyer; this wheel with the aid of a chain (foot = 12.7) transmits motion to the Z = 30 star wheel placed at end of the transmission shaft which rotates in two bearings arranged on the jacket of the unloading conveyer; at the other end of the transmission shaft is a link of a universal joint which, with the aid of the second universal joint link, connects the transmission shaft with the conveyer shaft of the fungicide bunker. At the other protruding end of the bunker conveyer shaft is a Z = 12 star wheel which with the aid of a chain (foot = 12.7) transmits motion to the Z = 30 star wheel on the stirring shaft of the fungicides bunker.

Fig. 2. General appearance of the "Stalinets-6" combine with the disinfecting device

[Begin p. 20]. The disinfecting device attached to the "Stalinets-6" combine was tested on the Persianov Sovkhoz, Rostov Oblast during the fall seeding operations of 1956. The combine with the disinfecting device and the seed-loader were placed on individual threshing platforms where wheat grain designated for treatment and planting was concentrated in heaps. Granosan was used as disinfectant at the rate of 1 kg per ton of grain.

The device was serviced directly by 4 workers: 1 — on the grain loader, 1 — at the combine, and 2 at the unloading pipe (receiving of

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treated grain into sacks or into tractor carts and onto the beds of trucks).

Safety measures during disinfection were applied in accordance with instructions.

Six hundred tons of seed-grain were disinfected during the testing period. Soem technically-economic indicators of the disinfection work done by the device are cited below: performance rate - 9-10 tons per hour; efficiency rate of the measuring device - 0.15--1.5 kg per minute; work consumption in man-days per ton of grain - 0.05; rate of efficiency increase in work (compared with the PU-1.0 disinfecting machine - 5.0.

The quality of grain disinfection was characterized by the following indicators: degree of adhesion of preparation to grain - 70.1%; degree of grain saturation with the preparation - 82.1%; degree of grain injury after disinfection - 0.08%; germination of seed following disinfection with granosan did not decrease and amounted to 96%.

Indicators of grain disinfection quality were determined for AB preparation; excepting the degree of injury and germination of seed which had been determined for granosan disinfection.

The device described can be recommended for use on farms with large grain crop areas.

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Trans. A-843
(In part)
vg/A

Chistov, I. F., Zafakovskaia, A. I., and Tarasova, A. G.

Poluchenie propionovoi kisloty.

[Production of propionic acid].

Gidrolizneia i Lesokhimicheskaia Promyshlennost', vol. 9, no. 6. pp. 13-15. 1956 301.8 G36

(In Russian)

CONCLUSIONS [p. 16]

1. The output of propionic acid in the process of trans-esterification of ethylpropionate increases with the increase in consumption for the reaction of acetic acid; its consumption, however, must not exceed 20% of the theoretically required amount. In the converse case, unfavorable conditions would be created for the separation of acetic acid from the propionic type.

2. Success of the trans-esterification process depends largely on the concentration used for the reaction of acetic acid. A concentration of acetic acid over 80% does not insure the formation of full azeotropic ester mixture - water, as a result of which distillation of ethyl acetate which contains no ethylpropionate is rendered difficult.

3. In the decomposition of sulfuric acid in the process of trans-esterification, there forms not only a sulfur dioxide, but also a tarry residue which renders distillation of propionic acid difficult. Hence, after the distillation of the basic portion of ethylpropionate, sulfuric acid must be neutralized with an equivalent amount of alkali hydroxide.

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4. Complete removal from propionic acid of ethylpropionate and other higher esters which failed to enter into exchange reaction can be achieved by means of restoring water from Florentine into the column in the form of phlegm. In the given case water is the antrener in the extraction of esters from the mixture of acetic and propionic acids.

5. The technological regime providing for the output of technical propionic acid in quantities of no less than 87% of the theoretically possible in the process of trans-esterification and marketing reactive acid no less than 71% in the process of rectification.

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Declassified and Approved For Release 2013/09/19 : CIA-RDP80R01426R010300030001-7 S. A-844
(in part)
vg/A

Chalov, N. V., Mel'nikov, N. P.,
Tsirlin, Iu. A., and Postnikova, N. S.

Kontsentrirovanie furfurola v parakh samoisparenii̇a gidrolizata bez zatraty tepla.

[Concentration of furfural in the steam of self-evaporating hydrolysate without consumption of heat].

Gidroliznaia i Lesokhimicheskaia Promyshlennost', vol. 9, no. 6. pp.8-10.
1956 301.8 G36

(In Russian)

CONCLUSIONS [p. 10]

1. A new method of concentrating furfural in steam of self-evaporating hydrolysate producing a 3--8% furfural solution without consuming heat in the process has been developed and tested experimentally.

2. On the basis of the data obtained, a new scheme was developed for the technological process of obtaining furfural from self-evaporating steam at hydrolytic-alcohol factories, which decreases steam consumption 15-20 times in the basic process of pectization of condensers containing furfural.

3. Adoptation of the proposed method by hydrolytic factories will permit the production of furfural at a net cost of approximately 1200 rubles per ton, i.e. three times less than the present cost.

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Trans. A-845
(In full)
VG/A

Imshenetskii, A. A.

Fermenty mikroorganizmov i ikh primenenie v promyshlennosti.

[Enzymes of microorganisms and their use in industry].

Priroda, vol. 45, no. 5. pp.17-26
May 1956 410 P933

(In Russian)

The science of ferments, later called enzymology or fermentology, was nonexistent a hundred years ago. Nonetheless, long before its emergence, the capacity of different "leavens" or "yeasts" to accomplish various biological transformations was well known. The active elements of such yeasts were microorganisms, and this similarity in microbe and ferment action lead to the fact that in the middle of the past century the first were called "organized" and the latter [group] "soluble" ferments.

The brilliant Louis Pasteur, having established the biological nature of fermentation, proved simultaneously that their generation of "heat" needed for the synthesis of substances of the microbe cell comprised their physiological importance. After the death of the outstanding physiologist, Claude Bernar, his unfinished article appeared in which he leaned toward the idea that fermentation is caused by a soluble ferment. The discussion that ensued in connection with the above between Bertlo, who shared Claude Bernar's viewpoint, and Pasteur concerning the energy importance of fermentation is of great historical interest. The erroneous idea that Pasteur had cdenied the participation of fermentative systems in fermentation is circulating in scientific literature. In reality this is not so,

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since he merely emphasized that he did not succeed in isolating the corresponding ferments.

Later M. M. Manasseina, and then E. Bukhner demonstrated that noncellular [beskletochnoe] alcohol fermentation was possible, and still later there appeared many reports concerning the character of action, methods of isolation and the chemical structure of different microorganism enzymes.

The diverse uses of microorganisms in the different fields of industry and agriculture are, in the end result, based on the activity of various enzymes found in the cells of microorganisms. The use of cultures of microorganisms that can be multiplied permit large scale reproduction of those sources of enzyme biosynthesis which in themselves are microbe cells. The characteristics of energy exchange are such that a comparatively light-weight microbe biomass is capable of decomposing or fermenting a considerable amount of animal or plant raw material. The use of microbe cultures, however, entails an accumulation of the most diverse products of activity, for example, organic acids, the presence of which is not always desirable. Besides, it is necessary to create optimal conditions for the growth of microorganisms which is not always easy. Hence the idea was conceived to use in industry individual enzymes isolated [Begin p.18] from a fungus mycelium or cells of bacteria. The possibility of producing rapidly the necessary biochemical conversions with the aid of enzyme preparations has a number of advantages over the use of living cultures of microorganisms. Thus, the decomposition of the protein of higher plants or animals can be achieved with the aid of putrefactive bacteria, yet the regulating of this process is complicated: a portion of the protein will be utilized by microbes to build up their body and as a

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source of energy, which unavoidably will lead to a loss of protein. Apart from this, there may accumulate in the medium such undesirable products as ammonia, hydrogen sulfide, indole etc. The task is simplified considerably by the use of protease of fungus or bacterial origin. Thus, protein hydrolysis is accomplished rapidly and without losses, and the degree of hydrolysis as a whole is determined by the character of the proteases, the time of their action and by the conditions created.

Wide-spread practical use of enzyme preparation of plant (chiefly malt containing amylase, protease and other enzymes) or animal origin principally pancreas which develop animal amylase and protease) in the different branches of the light and food industries has made it possible to work out demands to be made of enzymes.

The first reports concerning the feasibility of substituting enzyme preparations obtained from bacterial or fungus cultures for enzyme preparations of animal or plant origin appeared about forty years ago. In connection with the above, gradually ever new problems arose for microbiology and microbial biochemistry. It was necessary to explain exactly what types of fungi and bacteria possess the more active enzymes used in industry. Further, the complicated problem of growing microorganisms not only in large amounts, but also under conditions guaranteeing their highest enzyme activity had to be resolved. And, finally, centralized production of enzymes called for the development of relatively simple methods of obtaining concentrated highly active enzyme preparations that are easily transportable and satisfy the demands of the most diverse branches of the national economy.

There are a series of enzymes found in the cells of animals, the higher plants and microorganisms that have a general function. It is sufficient to point out protease, amylase, lipase, peroxydase and other ferments.

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Yet it would be wrong to assert that the formation, character and the features of the action of enzyme systems developed by microbe cells do not have their own specific characteristics. There is a series of enzymes known to occur only in the world of microorganisms which, as a rule, are not developed by animal or plant cells. For instance, assimilation of cellulose contained in feed by ruminants is possible only after the cellulose has been hydrolyzed by the enzyme cellulase which is formed by micoorganisms living in the stomach and colon of animals. The latter do not develop cellulase and without microbe-symbionts animals would die of starvation.

Exceptionally important to the national economy and magnificent in its scope is the process of biological atmospheric nitrogen fixation accomplished by microorganisms inhabiting the soil and water bodies. Soil fertility depends to a considerable degree on the activity of this group of microbes which, as a result of the action of specific enzyme systems, are capable of atmospheric nitrogen fixation, i.e. to bring about reactions which are unavailable to all other living beings of the plant or animal world.

In recent years it was demonstrated successfully that oxidation of ammonia into nitrites, i.e. the process of nitrification caused by chemosynthesisong bacteria can be reproduced by non-cellular autolyzates obtained from the cells of nitrifying bacteria.

The fermentative character of ammonia oxidation is interesting from the viewpoint of comparative physiology, since this kind of oxidising process is known exclusively in microbes in contrast to the well investigated reduction [vosstanovlenie] of nitrites and nitrates to ammonia. The feasibility of non-cellular reduction of ammonia nitrates was demonstrated [Begin p.19] by S. Z. Brotskaia who had studied this process using the cell juice of thermophilic denitrifying bacteria. We shall limit ourselves

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to the examples cited which illustrate the general situation: In the world of microorganisms, we encounter enzyme systems which have emerged as a result of adaptation to different environmental conditions not prevalent in higher plants and animals. This constitutes the first characteristic of "microbial enzymology".

The second characteristic is the unusually rich assortment of enzymes synthesyzed by the microbe cell. Bacteria and fungi can utilize a large number of the most diverse elements and compounds as a source of food and energy: hydrogen, methane, paraffin, lignin, chitin, sulfur, iron, cellulose, protein, sugar, alcohols etc. The means of transformation of the substances in the microbe cell are also varied. It is quite natural for microorganisms to be able to develop different hydrolases, dehydrases, oxidases, phosphorylases and other enzymes. The common black mold (Aspergillus niger) which frequently appears on bread forms about thirty different, by now well investigated enzymes. It is indisputable that the number, variety and activity of microbial enzymes are extraordinary. In this respect, the higher plants and animals cannot compete with them.

The third characteristic of microorganisms is the fact that, while they maintain continuous contact with their external environment and use it as a source of energy and food, they react exceptionally rapidly and fairly selectively to change in ~~their~~ habitat by reconstructing their enzyme systems. The recently developed science concerning adaptive and constitutive enzymes[1] has attracted the attention of representatives of different specialties: biochemists, geneticists, microbiologists and

[1] Adaptive enzymes are not developed by microorganisms, unless the medium has a substrate upon which they exert influence. In contrast to this, constitutive enzymes form under such conditions.

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physiologists. We shall refrain from setting forth the present situation of this problem and shall touch upon it only in connection with the practical tasks that have arisen in cultivating microorganisms the cultures of which produce enzyme preparations. Strictly speaking, every enzyme is adaptive, since it is difficult to imagine that any biological process of no physiological improtance would occur in a microbial cell.

Fig. 1. Colonies of the smooth and rough (at right) forms of Bacillus mesentericus

In changing cultivation conditions, we encounter either a weakening or strengthening of existing enzyme systems. It is much more difficult to prove that a change in conditions of life had led to "a new formation" of an enzyme that had not been in the cell heretofore. This question is complicated by the possibility that there had existed its inactive predecessors (zymogens) which under certain conditions convert to an active form. Some microbial enzymes are so constitutive that the capacity for their formation is retained even after a long cultivation of microbes in a medium lacking a substrate upon which the given enzyme exerts an influence. [Begin p.20].

Fig. 2. Zones of starch hydrolysis encircling 21-hour colonies of Bacillus diastaticus

Thus, after multiple reseedings of thermophilic cellulose bacteria on a medium lacking cellulose, but containing glucose as the only source of carbon, the bacteria, upon being transferred onto a medium with cellu-

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lose, began to ferment it rapidly. Consequently, regardless of the lack of cellulose within the medium, the bacteria had retained the capacity to begin immediately to form an enzyme that hydrolyzes cellulose - cellulase.

An entirely different picture is observed in cultures of the mold fungus Aspergillus oryzae. At the enzyme laboratory of the All-Union Scientific-Research Institute of the Alcohol Industry, headed by R. V. Feniksova, the fungus was cultivated by L. S. Smirnova on media containing different carbohydrates or glycerin. Then the content of amylase in the medium and in the fungus mycelium was determined. The result of these experiments are cited in table 1.

Table 1.

ADAPTIVE CHARACTER OF AMYLASE IN ASPERGILLUS ORYZAE

(synthetic medium with ammonium sulfate)

Source of carbon	Dry weight of mycelium (in gm)	Amylolytic activity (in units)		
		per 100 mg of medium	per gm of mycelium	Total
Glucose	1.72	Traces	Traces	Traces
Saccharose	1.76	0	0	0
Glycerin	1.52	0	0	0
Maltose	2.28	88.1	3.2	91.3
Dextrins	2.71	127.8	5.0	132.8
Starch	2.22	99.7	5.5	105.2

We see that amylase with glucose, saccharose and glycerin appears either in the form of traces, or not at all. Yet on media with maltose, dextrin or starch, the fungus synthesizes active amylase which is prevalent chiefly in the liquid medium and not in the fungus mycelium. It is interesting that a starch content, i.e. a substrate upon which amylase exerts its influence, is not absolutely necessary in the medium; the formation of amy-

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lase occurs also in the event the medium contains products of starch hydrolysis - maltose.

In *Aspergillus* amylase has a distinctly pronounced adaptive character and the fungus should always be cultivated on substrates containing starch.

The emergence and development of each new branch of the microbiological industry is indivisibly connected with the search for and selection of the cultures of microorganisms possessing the most pronounced, necessary and, in the given case, usefull properties. As far as the enzyme industry is concerned, there are many uses for bacterial and fungi cultures.

Among the bacteria, most frequently cultivated is *Bacillus mesentericus*, known also by the name of "Potato Bacillus", it produces active *a*-amylase, as well as protease. This species forms a characteristically wrinkled film on the surface of a liquid medium and its colonies on a solid medium (meat-peptone agar, potato) have a rough form.

Under laboratory conditions, *B. mesentericus* produces hereditary variants possessing morphological properties that deviate from those of the initial race. According to I. D. Kasatkina's observations, rough forms are capable of producing smooth variants which form a considerably less active amylase and protease per unit of the dry weight of cells.

Fig. 2a. Zones of starch hydrolysis encircling 21-hour colonies of *Bacillus mesentericus*

On fig. 1 are presented colonies of smooth and rough variants and on fig. 2 are cited data concerning the activity of the hydrolases of these two variants. The cultures of *B. mesentericus* are used for the manufacture of preparations of the "Rapidase" type utilized for more rapid saccharifi-

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cation of starch in beer production.

Table 2.

ACTIVITY OF HYDROLYTIC ENZYMES IN ROUGH AND SMOOTH FORMS OF BACILLUS MESENTERICUS UNDER CONDITIONS OF SUBMERGED CULTIVATION

(Age of cultures 24 hours)

Form of colony	Amylolytic activity of enzyme contained in 1 ml — Rate of solution flow (in sec.)		Proteolytic activity of enzyme contained in 2 ml — Rate of solution flow (in sec.)	
	Experiment	Control 1	Experiment	Control 2
Smooth	60	103	24	30
Rough	20	108	14	50

Control 1 - starch (2%) + water
Control 2 - gelatin (8%) + water

Considerable interest is aroused by thermophilic amylolytic bacteria possessing active amylase which liquefies starch sizing very rapidly at 80-90°. The thermophilic strain of Bacillus diastaticus, isolated in the Soviet Union, on the surface of solid media with starch, forms colonies which discharge enzyme amylase onto its surrounding environment. By treating the medium surface with iodine, it is possible to obtain a colorless zone of starch hydrolysis around the colony. In colonies of the same age, the hydrolysis zone of Bacillus diastaticus is considerably wider than in the mesophilic strain of B. mesentericus, as indicated on fig. 2 and 2a. Reproduction of thermophilic bacteria on a 10% potato decoction occurs in an aerated culture exceptionally rapidly and terminates after 8 hours. (Fig. 3).

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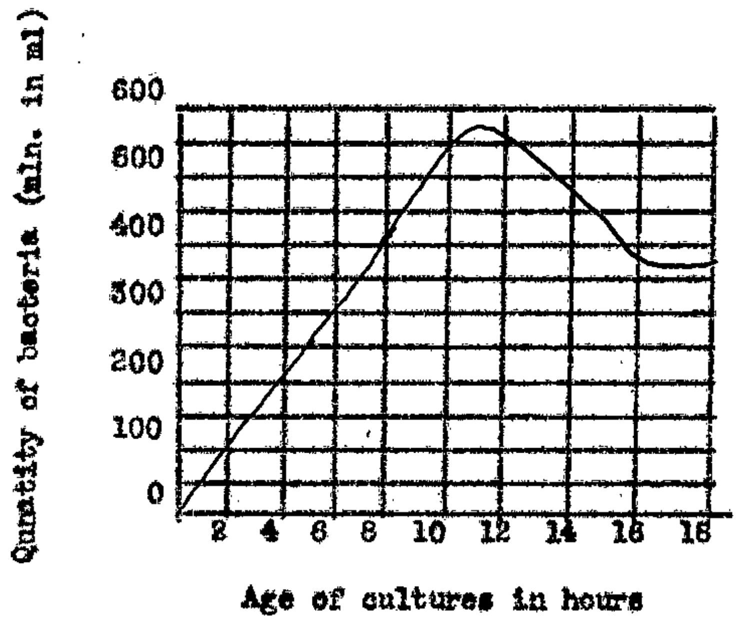

Fig. 3. Reproduction curve of thermophilic amylolytic bacteria

Under the influence of amylase, saccharification of starch contained in the medium occurs in liquid cultures. Fig. 4 shows that it proceeds much more intensively in a culture of the thermophilic amylolytic bacterium B. diastaticus than in cultures of B. mesentericus.

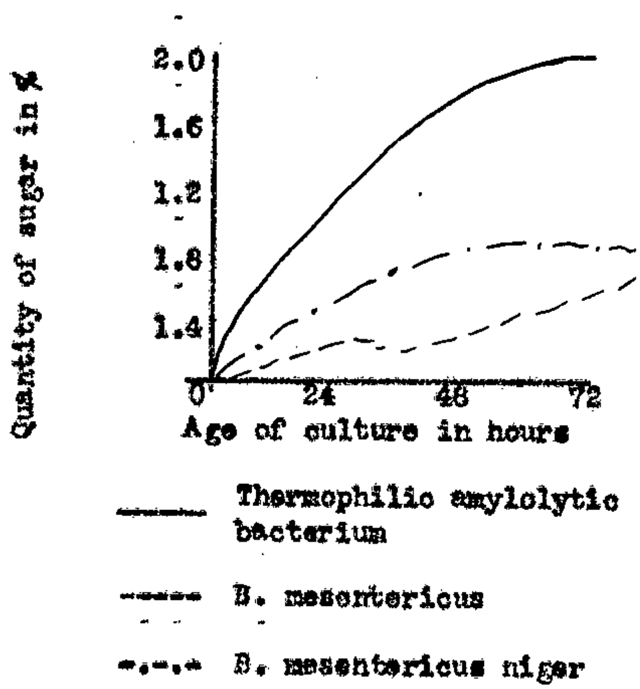

Fig. 4. Saccharification curve of starch in cultures of thermophilic

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On the initiative of the Institute of Microbiology, Academy of Sciences USSR, a pilot plant installation that produced a concentrated preparation of bacterial amylase was created in the Kirgiz SSR for the reproduction of B. diastaticus. Later, there was isolated a culture of the thermophilic butyric acid bacterium that also produces active amylase and multiplies rapidly. It had certain advantages over B. diastaticus, since this strain, a member of the anaerobes, can develop in a high liquid column without any air blowing through it. The technological scheme of obtaining concentrated preparations from cultures of thermophilic, butyric acid bacteria was developed by F. M. Kinsburskaia at the All-Union Scientific-Research Institute of the Alcohol Industry. Bacteria, especially the thermophilic type, have a number of advantages over fungi. They multiply more rapidly under conditions of depth and their cultures are not so readily contaminated by alien microorganisms which inactivate amylase. The amylolytic complex produced by bacteria is, however, distinct from a analogous fungi complex. Fungus amylase is better at saccharifying starch, hence the interest that has arisen in the production of fungi amylase, capable of replacing grain malt, can be understood. In the East, chiefly in China and Japan, fungi of the Mucoraceae family[mukorovye], as well as Aspergilla, have been used long since in saccharification of starch. While developing on rice, fungi cultures saccharify the starch, and then soluble carbohydrates are fermented by yeasts thus forming alcohol. It is no coincidence [Begin p.22] that the more active Aspergillus that forms amylase is named Aspergillus oryzae (rice Aspergillus).

The practical importance of fungi as producers of hydrolase enzymes, naturally, encouraged their selection which usually is accomplished in two

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stages. First, a more active culture (with regard to the given property) is searched in nature, and then, its activity is increased experimentally. An extensive search in nature (beer, grain, food products etc.) has led to the isolation of a large number of cultures of Aspergillus and Mucoraceae fungi. A detailed study of the fermentative

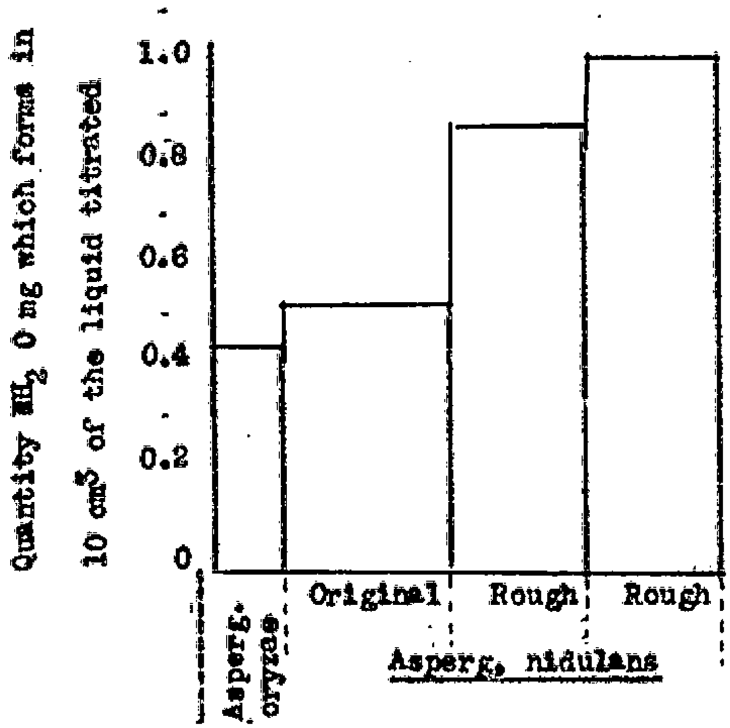

Fig. 5. Graph of proteolytic activity of Aspergillus oryzae, wild form of Aspergillus nidulans and its cultural form

activity made it possible in a number of cases to find cultures with a higher activity than is found in industrial strains. Thus, according to data of S. Z. Brotskaia, Aspergillus nidulans produces more active proteases than Aspergillus oryzae used in obtaining proteolytic enzymes. This wild form of A. nidulans was exposed to ultra-violet rays and, as a result, the variant obtained was stable, formed colonies of rough forms and possessed a 2--2.5 times higher proteolytic activity than the original wild form

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(fig. 5). Right now scientific-research establishments conduct selection work with the objective of developing active races of Aspergilli that produce active amylase, protease or pectinase. Distinct from selection of cultural plants, the selection of fungi and bacteria that have found practical application has just begun, and there is no doubt that, as a result of this work, the useful properties will be increased also in microorganisms.

For the last thirty years, enzyme preparations of microorganisms have gradually been replacing preparations obtained from plant or animal raw material. The question naturally arises as to how this preference is to be explained. Let us list briefly the advantages possessed by microbes in the given case.

1. The rate of microbe reproduction is so high that a huge volume of cultures of a certain microbe strain can be accumulated in a comparatively short time. Mold fungi (Aspergilli) require 36 hours for their development, sporebearing bacteria - 20--24 hours, and some thermophillic bacteria complete their growth within 6-7 hours, multiplying at 60° in the top layer of the culture medium through which air passes. It can be asaid without exaggerating that under factory conditions, there can be collected 100 to 1000 harvests of mold fungi or bacteria within a year. This rapid reproduction of biomass constitutes one of the essential characteristics of microorganisms.

2. Reproduction of microorganisms which form practically important enzyme systems can be accomplished on production waste or on culture media prepared from inedible raw material, while malt or animal tissues are food raw materials. It is, forainstance, sufficient to point out that the mold fungus of Aspergilli, the amylase of which is required fora alcohol production, can be grown on the residual liquid left in alcohol production

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after distillation. Considerable interest is aroused also by the possibility of growing microorganisms on simple culture media composed of different salts. Sometimes good growth is observed on very cheap substrates, thus, Bacillus diastaticus, a thermophilic, sporebearing bacterium, which forms very active amylase, develops on a 5% potato concoction.

3. Essentially, the biochemical activity of microorganisms can be exceptionally high. In comparing the latter with the enzymatic activity of plant cells, one must draw the conclusion that per unit of dry weight of the biomass, microorganisms produce more active enzymes than animals or plants. This difference appears particularly clear in comparing a light weight amount of reproduced bacterial cells [Begin p.23] which have formed active enzymes with the weight of cereal grain from which malt is prepared.

4. Thanks to the smallness of microorganisms and to their rapid reproduction, favorable conditions were created for the direction of their development under factory conditions. In growing higher plants, our possibilities are limited in some measure by climatic or seasonal conditions. In contrasts, for microbes, any regime of nutrition, aeration, temperature, reaction of environment etc. can be created easily. Consequently, the experimenter as well as the technologist work under exceptionally good conditions.

Here the basic advantages of microorganisms over higher plants are enumerated. These factors determine the need for gradually replacing the enzymes of animals and higher plants with microbial enzymes.

In reproducing microorganisms in large amounts, the most progressive method must be considered submerged cultivation. Every development in the microbiological industry for the last ten years indicates its advantages over the surface method of cultivating microbes, in a thin layer of a

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liquid or solid (for example, bran) medium. The transition from the surface method to the depth method was realized rapidly in the antibiotic industry in obtaining penicillin, in the production of vitamin C (oxidation of sorbite into sorbose by bacteria), this method was adopted for the production of vaccines and also in obtaining citric acid with the aid of Aspergillus fungi. Microorganisms that produce enzymes can also be cultivated under these conditions. It is especially convenient to grow in deep culture media anaerobic bacteria which produce amylase, since it eliminates the need to blow air through the layer of liquid media.

Fig. 6. Gradual development of the mycelium and the formation of conidiophores of *Aspergillus oryzae* fungi on bran.

Thermophilic aerobic bacteria multiply with extraordinary speed at 60° [C] when the medium is aerated. The whole production cycle is completed within 6--7 hours.

The development of *Aspergilli* under conditions of deep cultivation proceeds fairly rapidly, but up to now it has, unfortunately, been impossible to obtain high amylase activity in a cultural liquid, and the occurrence of alien microorganisms in fermenters leads to inactivation of amylase. Parallel with improving the deep method of cultivation, the older, surface method of *Aspergilli* cultivation method is also being improved. Fungus conidia are seeded upon sterile, moist wheat bran found in vessels. The fungus mycelium germinates through the entire thickness of the bran. Fig. 6 illustrates the enlarged pieces of bran on the surface of which appear *Aspergilli* conidiophores. Very active amylase is produced in growing *Aspergilli* by the surface method, but this method is labor consuming and

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calls for the construction of very large chambers for the accomodation of vessels. The fungus culture grown on bran is sometimes called "fungal malt".

Yet the use of the so-called "fungal malt", as well as liquid culture of fungi or bacteria is expedient only where the microorganisms themselves are grown. The enzymes comprise a small portion of the weight of the liquid or vegetation mass upon which bacteria or fungi have grown. Hence installations for fungi cultivation are organized in places where the cultures are used directly, particularly, [Begin p.24] in bakeries and at alcohol factories and plants that produce fruit juices. In the future, however, it will be necessary to organize centralized production of concentrated enzyme preparations. In such a case enzymes will be extracted from fungi cultures, and then concentrated preparations will be obtained by different methods. There are several methods: adsorption of enzymes with adsorbents such as silical gel, bentonite etc., drying of liquid containing enzymes with the aid of a spray drier, precipitation of enzymes from liquids with ammonium sulphate or alcohol.

The problem of obtaining concentrated enzyme preparations is of very great practical importance. Organization of large enzyme factories will require the use of more improved methods of increasing the activity of preparations per unit weight. Only thus will their transportation and use in industry be realized.

The field of the practical application of microbial enzymes is exceptionally wide. The proteases of fungi and bacteria are used to remove hairs from furry raw material. Under the influence of protease, there occurs a weakening of the bond between the hair-bulb and the papilla upon

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which the bulb rests, and after enzyme action the wool is removed with the aid of special machines.

As demonstrated by the works of V. G. Babakina, removing hairs by enzyme action has a number of advantages over the method based on the application of chemical substances. The latter proceedure leaves much to be desired with regard to sanitation. Aspergilli proteases are used also in the softening of hides - a process that is also accomplished with the aid of proteases contained in animal pancreas (pancreatin). Replacement of enzyme preparations obtained from Aspergilli cultures for the expensive pancreatin is desirable in every respect.

Enzymes that decompose protein are used also by the textile industry in removing sericin from the surface of silk fabrics, in desizing fabrics covered with the sizing composed of casein or gelatin, and by the moving-picture industry to removed gelatin emulsion from films.

Fig. 7. Action of pectinase enzymes produced by the Aspergillus fungus. Left - fruit juice before enzyme action, right - transparent juice clarified by pectinase through which figures on table are well visible.

Considerable savings can be achieved by adopting fungus protease preparations for the production of vaccines. Under the influence of fungus enzymes, it is possible to obtain protein hydrolysates required for the preparation of rich culture media used in cultivating large amounts of different pathogenic bacteria that further are utilized in the preparation of vaccines.

The use of enzyme extracts from Aspergillus cultures exposes the treated substrate to the entire complex of enzymes contained in the given ex-

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tract, particularly in the brewing industry where plant raw material is exposed not only to the action of the amylolytic complex, but also to Aspergillus proteases. As a result of the decomposition of proteins by proteases, conditions are improved for the reproduction of yeasts which accomplish alcohol fermentation in the production of alcohol or beer.

Amylase preparations obtained from bacterial and fungi cultures enjoyed an even wider distribution. Bacterial amylases possess the capacity to decompose rapidly starch into dextrins. The textile industry uses extensively sizing composed of starch. [Begin p.26]. To remove sizing from cotton fabrics or artificial silk, these fabrics are exposed to the action of bacterial amylase. Amylase of thermophilic amylolytic bacteria is best for this purpose, it helps to remove starch within ten minutes, which permits the desizing of fabrics without breaks and without wetting them. Fungal amylase possesses the greatest capacity for saccharification, but in the given case this quality is superfluous, since full saccharification is not needed to remove starch from fabrics. With respect to the first stages of starch decomposition, bacterial amylase is much more active than the amylase of fungi, particularly of Aspergilli.

In contrast to this, amylase preparations from bacterial cultures are inadequate in cases that require full saccharification of starch. Amylase, dextrinase and maltase contained in fungi provide saccharification of starch to glucose which can be well fermented by yeasts; precisely for this reason fungi are being used in the alcohol industry. An Aspergillus culture grown on bran (a so-called fungal malt) is added in the amount of 5.5--6% to the saccharification of pasty starch. As a result of the action of all enzyme systems, there occurs not only saccharification of starch, but also hydrolysis of a number of other substances containing carbohydrates that are found

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in plant raw material (hemicellulose, pectin and others) with the formation of reducing substances which are also fermented. These enzymes, obviously, are absent in grain malt, since in using "fungal malt" the output of alcohol per ton of potatoes or grain is higher than the earlier theoretical rates. A long study of the conditions of Aspergillus cultivation by the surface method, conducted at the All-Union Scientific-Research Institute of the Alcohol Industry helped to organize production of "fungal malt" under factory conditions. A complete substitution of fungal malt for grain malt became a reality, and the Serebriano-Prudskii Alcohol Factory has been working successfully for four years and is accomplishing saccharification of starch by fungus enzymes. At the same institute, a method for depth cultivation of Aspergillus has been developed for this purpose. At present this method is being tested at the Michurin Alcohol Factory.

Enzyme preparations of Aspergillus have begun to be used in the brewing industry. They make it possible, in part, to substitute ungerminated barley for malt, which is of economic importance. Another new method is the substitution of fungi cultures of Aspergillus for grain malt in bakeries in the production of superior types of black bread. Under the influence of enzymes, proteins and the starch of grain are exposed to partial decomposition and saccharification which tends to increase the taste and nutritive properties of the bread.

Among the enzymes derived from black Aspergillus (Aspergillus niger), pectinase which accomplished hydrolysis of pectin substances has been well investigated. Decomposition of these substances underlies the retting of flax which is accomplished by bacteria that develop this enzyme. Fungus

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pectinase has long since found practical application. The presence of pectin in fruit and berry juices renders them viscous and cloudy. Under the influence of fungi pectinase, juices clarify excellently (fig. 7). In cultivating cultures of Aspergillus that produces active pectinase, the raw material used contains pectin (for example, finely cut carrots); fairly good pectinase is produced in developing the fungus on bran. The dried and pulverized fungus culture is released as an enzyme preparation under different names ("Klaraza" etc.).

In different countries, chiefly in the USA and Japan, there are specialized concerns manufacturing preparations of bacterial and fungus enzymes that are used extensively in industry. The history of the development and successes of enzymology and the enzyme industry in our country and abroad warrants noting some prospects for further work. Practical utilization, and, consequently, the release of the appropriate enzyme preparations, is at present limited, primarily to three enzymes: amylase, pectinase and protease. Meanwhile, microorganism enzymes have in recent years been studied so intensively that the idea of a possible practical utilization [Begin p.26] of a number of other enzymes is arising even now. Let us point out some possibilities. The largest source of carbohydrate of organic compounds found on our planet is undisputedly wood. Recently, the hydrolytic industry emerged as a special branch that accomplishes acid hydrolysis of cellulose and pentosans with the subsequent production of alcohol and fodder yeasts from the products of hydrolysis. In connection with the above, extraordinary interest is aroused by investigations of the cellulose enzyme produced by fungi which, while developing on wood, are capable of accumulating reducing substances. Enzyme hydrolysis of wood

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is a complicated task the solution of which, naturally, calls for great efforts, but it is realistic.

In a number of cases considerable interest is aroused by the decomposition of fats with the aid of microbe esterase (lipase). This pertains, particularly, to degreasing animal wool. It must be noted that, in their activity, lipases of higher plants are inferior to lipases of some microorganisms. As regards other enzymes, it must be pointed out that production of peroxidase of microbe origin is desirable, because it would furnish an opportunity to control the process of aging wine. Thus, in the future, the "assortment" of enzyme preparations obtained from microorganism cultures will undoubtedly be expanded. One of the fundamental tasks is the creation of specialized, independent branch of industry manufacturing enzyme preparations. Up to now, there are only installations for the cultivation of microbes produced for the needs of a certain manufacture. Organization of large concerns releasing various enzyme preparations will stimulate research work in the realm of technical microbiology and biochemistry. They are facing very concrete problems: developing of methods for the cultivation of microorganisms in large amounts; improving processes that aid in obtaining concentrated, highly active enzyme preparations; recommending technological schemes for obtaining individually the specific enzymes produced by a given culture of microorganisms simultaneously. Thus, it is extremely desirable to release proteases that do not contain amylase, and, conversely - preparations of amylase devoid of proteases. Purified preparations of certain enzymes are needed not only for the various branches of industry. Their lack is felt acutely also by scientific-research establishments, since, to begin with, enzyme preparations are required for investigations in the sphere of enzymology.

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Organization of an enzyme industry utilizing microbe cultures will enable a number of branches of our economy to improve the technology of various production processes and to substitute enzyme preparations for many thousands of tons of grain. Concomitantly it will arouse more interest in the study of different enzyme systems of microorganisms some of which will, undoubtedly, be utilized in practice in the future.

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Trans. A-846
(Abstract)
vg/A

Nastoichivo pasprostraniat' peredovoi opyt.

[Promulgating continually the results of advanced experience].

Gidrolisnaia i Lesokhimicheskaia Promyshlennost', vol. 9, no. 6, pp.1-2. 1956. 301.8 G36

(In Russian)

The Communist Party is developing the initiative of the working masses for technological improvement and innovations. At its 20th Congress it emphasized the importance of disseminating the experience of leading workers and concerns - this would increase the products used in industry. Specialists of the First Kaliningrad Cellulose Paper Pulp Trust have adopted the method of digesting cellulose with alternating hydrolytic pressure and have thus increased production without additional disbursements. In July of 1956 alcohol production was increased one and a half times, which brought the output to 70 liters per ton of cellulose, and surpassed planned quotas by 500 decaliters per day [24 hours].

Workers of the Arkhangelsk Cellulose Paper Pulp Trust followed the example of the Kaliningrad Trust with excellent results. At the April meeting of workers of the Sulfite-Liquor [spirtovoi] Industry, Tovarishch Andreev, Manager of the Alcohol Factory of the Vyborg Cellulose Paper Pulp Trust reported a successful change in turning from sedimentation of neutralized alkali to the separation of suspended particles in the vortex purifier which can be used effectively to purify and clarify neutralizates [neitralizata]. The amount of fermenting sugar and the yield of alcohol obtained in hydrolysis of wood depends on the correct heating capacity of the hydrolysis apparatus.

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Leading hydrolysis factories have long since established self-recording manometers on hydrolysate discharge lines of each apparatus. The Kama Trust has established ampermeters on separators so the load of each separator can be watched.

Valuable examples disregarded by some concerns are: the experience of the Siriusinsk Hydrolytic Factory in achieving high efficiency of its fundamental equipment; experience in regulating the hydrolytic process according to RV [disolved substances], content in hydrolysate at the Kansk Hydrolytic Factory; experience of the Lobvinsk Hydrolytic and Priozersk Sulfite-Alcohol Factories [Begin p.2] in mechanical foam-extinguishing in yeast growing tanks; experience in using radioactive isotopes in incontrolling and regulating the capacity level of liquids at the Leningrad Hydrolytic Factory; experience in replacing non-ferrous metals in the column for the rectification of acetic acid at the Dmitriev Wood Pulp Chemical Factory, etc.

Procrastination of directors of administrative agencies and of branch institutes to study measures developed by specialists and to promote their use is causing industry serious losses. Inertia and bureaucracy are likely to kill any creative undertaking if they are allowed to continue. Hydrolysis factories are in need of tree felling equipment. Tovarishch Fadin, of a Leningrad factory constructed a six-blade chipping machine several years ago, yet by now not even an experimental sample of it has appeared. Directors of the Main Administration of the Hydrolytic Industry make ardent speeches, but do nothing practical. Tovarishch Karpenko, Directory of the Krasnoiarsk Hydrolytic Factory commented justly about the lack of interest in the experience of factories, the lack of

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publicity and coordination of technical policies.

Information on the Leningrad and the Kansk Conferences published in the present issue of this journal describes measures designed to increase the output of alcohol, yeasts and furfural at a decreased net cost. Failure of the Main Administration of the Hydrolytic Industry to fulfil commitments for the first half of 1956 was due to the fact the Main Committee made no effort to carry out recommendation adopted by the Leningrad and Kansk meetings. The method of the Khakassk factory which remodeled its wood chipping installation so as to obtain fine shavings has been adopted by very few. Assistance and publicity rendered by VNIIGS [All-Union Scientific-Research Institute of Hydrolysis and Sulphite Alcohol Industry] is still inadequate. In complimenting Solikamsk workers for fulfilling their socialist obligations, the Board of the Ministry of the Paper Pulp Industry USSR and the Presidium of the Central Committee of the Workers Trade-Union of the Forest, Paper Pulp and Wood Processing Industry obligated farm managers and trade-Union organization to improve the study and dissemination of advanced experience. A means of publicizing experience are special seminars, preferably on the spot as did the resin workers of the Kosulinsk Forest Industry Kolkhoz. The Main Committee has organized no seminar since November 1955 when operators exchanged experiences at the Siavsk Wood Pulp Chemical Trust. Contact with related industries is also beneficial. A trip of engineering technicians of the Ashinsk Wood Pulp chemical Trust to the Vladimir Factory of the Ministry of the Chemical Industry USSR for an exchange of experiences in regenerating acetic acid proved useful. After the trip, the wood pulp chemists improved the con-

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struction of their extractor and installed control-measuring sets. Chemists of the "Metil" factory borrowed from the Kuskov factory the method of rapid gas analysis.

The role of production conferences must be elevated, for it is the only form of participation the working people have in production management. Directors of Soviet concerns must have the ability to listen to the advice of workers and to use their life experience in solving problems. All barriers to progress must be removed.

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Trans. A-847
(In full)
vg/A

Soveshchaniia po novoi tekhnike i obmenu opytom v gidroliznoi promyshlennosti.

[Conferences on new techniques and exchange of experience in the hydrolytic industry].

Gidroliznaia i Lesokhimicheskaia Promyshlennost' vol. 9, no. 6, pp.27-28. 1956. 301.8 G36

(In Russian)

Conferences of workers of the European, Ural and Siberian hydrolytic factories were held at Leningrad and Kansk in April and May of 1956. Among the delegates were leading workers, engineers, technicians, experts and representatives of scientific and planning branch institutes and of the Main Administration of the Hydrolytic Industry.

At Leningrad, the report concerning the fundamental tasks of the hydrolytic industry in 1956 was read by V. A. Kucherenko, Chief of the Main Administration of the Hydrolytic Industry. K. U. Krut'ev, Head Engineer of the Leningrad Hydrolytic Factory and V. I. Karpenko, Director of the Krasnoiarsk Hydrolytic Factory shared the experience of their establishments in increasing the output [s'em] of alcohol per 1 m^3 capacity of the hydrolytic apparatus; F. P. Runtso, Chief of the Production Division of the Main Committee, reported on increasing labor efficiency at hydrolytic factories; P. P. Kremlevskii, Manager of the Automation Laboratory of VNIIGS [All-Union Scientific-Research Institute of the Hydrolytic and Sulfite-Alcohol Industry] reported on work concerning automation of hydrolytic production etc.

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Conference delegates at Kansk heard and discussed the report of M. I. Mikhailov, Head Engineer of the Main Administration of the Hydrolytic Industry, on utilizing technical capacity of factories and on the basic tasks of the Hydrolytic Industry in 1956, and reports of head engineers of the Biriusinsk, Krasnoiarsk and Kansk factories on experience in the work of their concerns. Statements of the representatives of the leading Biriusinsk factory telling how they had achieved a record output [s'em] of alcohol - 120.8 liters per m³ of the projected capacity of the hydrolytic apparatus - aroused the interest of those present. The alcohol of the Biriusinsk factory is the cheapest in the industry.

Workers of the Krasnoiarsk factory reported positive results obtained from adapting mechanical foam-extinguishing to yeast production, time saving of up to 10-12 hours in planned maintenance repairs of equipment, and an increase in the time of its service between repairs; production workers of the Kansk factory shared their experience in raising the profits of their concern, particularly of the yeast section. Representatives of the Khakassk factory attracted the attention of the conference when they told about a 30% increase in the sugar output obtained from digesting by means of cutting up raw material into small pieces with a reconstructed cutting machine, and also about adapting the method of directed crystallization of gypsum in the neutralizate; the brewers [varshchiki], Comrades Kornilov, Logunov, Sokolova and others told about their experiences in working efficiency.

Delegates who submitted reports criticized severely the shortcomings in the work of the Ministry, the Main Committee, of concerns, and of scientific-research and planning institutes. The critical comments of the

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production workers and their suggestions were reflected in the resolutions adopted by the conferences.

It is provided in the resolutions that the primary tasks include a further improvement in the technique of hydrolysis production, decrease in the hydromodule, yet at the same time retaining or improving the qualitative indicators, [and] automation of the establishments. Scientific research work done at VNIICS must be expanded, and at Giprogidrolis [State Institute for the Planning of Hydrolytic Plants] - the planned work for complex automation of alcohol, yeast and furfural production, the development of technical assignments for regulating and measuring apparatuses and automatic regulators necessary to the hydrolytic industry must be completed more rapidly. The Conferences recommended that production of specific sets of regulators and guiding mechanisms for the hydrolytic industry, which are not manufactured by native industry, be organized within the current year in one of the hydrolytic factories; The Main Administration of the Hydrolytic Industry is to develop structural and staff specifications for a "bureau for regulating and measuring apparatuses" [KIP]; the State Institute for the Planning of Hydrolytic Plants is to prepare in 1956 a draft for a model repair shop for KIP and for automation facilities and to work out a more perfect construction of a quickly closing lid of the hydrolytic apparatus.

The Conferences resolved that it was necessary to find methods for a further reduction of the operations [oborot] of the hydrolytic apparatus by decreasing the time consume by subsidiary operations and by repairs. To determine the optimal relation between diameter and height of the hydrolytic apparatus, VNIIOS in conjunction with "Gipregidrolis" are to study carefully the apparatuses of the Khakassk factory and, apart from

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this, are to test there hydrolysis with excess pressure in an apparatus with elongated rays of the filtering arrangement, and they are to submit their recommendations by the 1st of October 1956.

The Conferences recommended lining all hydrolytic apparatuses at all hydrolytic factories with carbon slabs. The Main Committee is to arrange in 1956 for all liners [futerovshchiki] to study the experience of using carbon slabs at the Leningrad factory. VNIIGS and "Giprogidrolis" are to hasten the development and testing of the continuous process of hydrolysis.

An important place in the resolutions is assigned to the problems of preparing raw material and of improving its quality. All hydrolytic factories have been advised to adopt immediately the experience of the Khakassk factory in remodeling chipping machines so as to obtain shavings no larger than 15 x 15 x 5 mm. and, in connection with this to re-examine the technical specifications for shavings in the third quarter of 1956; VNIIGS and "Giprogidrolis" are to find in 1956 a more effective method of condensing raw material in the hydrolytic apparatus; to organize this year and in the first half of 1957 at all hydrolytic factories sorting-before-pulverizing stations insuring the production of raw material that will meet the requirements of technical specifications; to replace in 1956-1957 obsolete crushers at forest trusts that supply raw material to hydrolytic factories with DM-5 crushers; the Main Administration of the Hydrolytic Industry and "Giprogidrolis" are to develop in 1956 a model mechanization scheme for work to be done at raw material exchange centers and warehouses.

The conferences found it expedient to recommend expanding the exist-

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ing progressive-bonus system of remuneration for qualitative indicators for workers of raw material mills and deputy directors for raw material and fuel.

There is in the resolutions criticism of the tendency to increase the share of shavings in the raw material mixture and to decrease the share of sawdust and chips. This leads to an unjustified increase in the net cost of alcohol.

In the sphere of technology it is recommended to adopt the method of directed crystallization of gypsum in a neutralizate that was developed by VNIIGS and was tested at the Khakassk, Krasnoiarsk and Tavdinsk factories, and, in connection with the above, to re-examine the consumption rate of ammonium sulfate; to improve methods of continuous separation of residue from its washings, having hastened the selection of the appropriate equipment; by September 1, 1956, VNIIGS is to generalize the experience of fermenting and separating stations of the leading factories with the objective of making corrections in the regime of waste liquid fermentation, separation of yeast, and in the rules of the technical exploitation of equipment.

An important place in the Conference resolutions is reserved for the problems of expanding yeast production. It is necessary to accelerate completion of shop construction for yeast at the Kos'vinsk, Khor and Tulun hydrolytic factories; VNIIGS is to develop economical methods for increasing the sugar content in processed waste liquid up to 0.7-1%; VNIIGS and "Giprogidroliz" have assumed the responsibility of examining by August 1, 1956 the technology of yeast production and the equipment used with the objective of simplifying it to the maximum; they are to develop a more efficient construction of yeast-growing tanks; to assist factories in 1956

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to adopt mechanical foam-extinguishing which eliminated fully the need of chemical foam-extinguishing.

The Conferences called the attention [of the delegates] to the need of utilizing better the waste of hydrolytic production for the purpose of complex processing of raw material. In the course of 1956-1958, all active hydrolytic factories must install equipment for the production of furfural from steam of self-evaporating hydrolysate; the Kansk, Krasnoiarsk and Andizhansk factories must immediately stop [Begin p.28] pouring condensate down the drain without distilling its furfural content. In the second half of the current year VNIIGS is to conduct industrial tests of the installation for the concentration of steam condensates of self-evaporation.

As regards problems of heat utilization, the Conferences decided that in 1957 all hydrolytic factories will have to bring specific steam consumption up to planned rates. VNIIGS and "Giprogidrolis" have to adapt in 1956, to the Kos'vinsk and Tulun factories, the heat utilizing scheme that provides for water heating up to no less than 140° in the front of the water heating columns; by September 1, 1956, they are to assist the Khakassk factory in adopting vacuum-refrigeration of neutralizate and four-stage evaporation of hydrolysate; the Main Administration of the Hydrolytic Industry is to provide the factories in 1956-1957 with the necessary number of plate [plastinchatyi] and spiral heat exchangers.

The Conferences note a number of measures aimed toward increasing labor efficiency. The most important of these are complete mechanization in 1956-1957 of hard and labor consuming work, reduction of length of standstills of establishments for repairs, wide-spread unfolding of socialist competition, teaching workmen a second profession, and adjustment of the wage system.

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Production workers immediately discussed among themselves the problems that were of interest to them, they advised each other as to methods of eliminating various kinks. At the shops of the Leningrad and Minsk factories, workmen, experts and heads of shops shared their accumulated experience with each other at the place where the work is done.

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Tokhtuev, A. V.

Selektsiia i semenovodstvo iachmenia i ovsa.

[Selection and production of barley and oat seed].

In Sibirskii Nauchno-Issledovatelskii Institut Zernovogo Khoziaistva. Voprosy zemledeliia v Sibiri, p.103-117. Moskva, Gosudarstvennoe Izdatel'stvo Sel'skokhoziaistvennoi Literatury, 1956. 100 S112V

(In Russian)

SELECTION OF BARLEY

As a result of selection work, 21 barley varieties have been submitted for State variety testing, 3 of these varieties are still undergoing tests and 4 have been regionalized:

Omskii [Omsk] 13709 - for the 3rd, 4th, 5th and 6th zones (the northern and southern forest steppes and the steppe zone) of the Omsk Oblast;

Omskii 10664 - for some zones of the Altai Territory, the Eastern-Kazakhstan and the Western-Kazakhstan Oblasts;

Omskii 11464 - for the Aleisk steppe of the Altai Territory foothills under irrigation;

Omskii 3601 - for the southern forest steppe of the Krasnoiarsk Territory foothills.

Omskii 13709, the best of these varieties, was developed by individual selection from local barley obtained from the Slavgorod District.

Since 1951, the Omskii 13709 variety has been tested also for the Lower Taiga [Siberian forest] zone where it produces good yields.

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In 1950, the SibNIIZkhoz [Siberian Scientific-Research Institute of Grain Economy] obtained a 40.6 centners per ha [76.0 ha per a] of barley yield from the Omskii 13709 variety, and in 1954, on the Cherlak State Variety Plot - 44.4 centners [83 ha per a.]. The Omskii 13709 variety produces satisfactory yields even in dry years.

The Variety proved to be resistant to Helminthosporium; its susceptibility to smut is below average. In addition, Omskii 13709 possesses sufficient resistance to lodging and shattering and it has a large grain. This variety belongs to the Nutans type and is distinguished by the following morphological characteristics. The straw stands erect, its spikelets are crescent-shaped, anthocyan colored, the two-rowed spike is smooth, of average thickness and yellow colored, the grains are glumaceous; the awns are jagged, of average roughness, long and yellow; [Begin p.104] pubescence of the spike rachilla and the spike glumes is hairy, transition of the lemma into an awn occurs gradually.

The grain is elliptical, yellow with a purple tint on the nerves of the floret, and it is large; the palea is of average roughness, there are little barbs [teeth] on the nerves; the basal bristle of the kernel is longhaired.

Fig. 1. Two hybrid naked-grain varieties - N-12 Nudum and Omskii 13709

The new varieties of SibNIIZkhoz, Abrek (Omskii 6164) and Vitiaz' [Knight], were submitted for State variety tests in 1947 and 1948 and they are [now] being tested [Begin p.105] on variety plots of the Omsk and other oblasts.

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These varieties mature 4 to 5 days earlier than the regionalized varieties, Omskii 13709 and Viner, but, as a rule, fall short of their productivity.

The Abrok variety undergones industrial tests on the kolkhozes and sovkhozes of the MOmsk Oblast' on an area exceeding 5000 ha (in 1955, 5158 ha). A shortcoming of this variety is the tendency of its straw to lodge.

All varieties listed above were developed by the method of individual selection from samples of local Siberian barleys and from samples of the world collection of VIR [All-Union Institute of Plant IIndustry].

Since 1939, barley selection has been conducted by the method of hybridization. At first this work was done on a small scale, but it was considerably expanded in subsequent years. The larger number of crossings was carried out for the purpose of developing naked-grain barley varieties. By means of complex hybridization and subsequent selection, a considerable number of lines distinguished by good, large grains and tall, stable straw were developed.

The varieties of SibNIIZkhoz are more productive compared to the naked-grain varieties of the Tulun and Narym selection stations.

INTERVARIATAL CROSSINGS AND NATURAL HYBRIDIZATION OF BARLEY

To improve seed types of the regionalized variety Omskii 13709, intervarietal crossings have been conducted every year beginning with 1949.

The method of such crossings is generally accepted: the maternal variety is seeded with a seeder in 1--2 rows, surrounded by mixtures of the best barley varieties, hulled as well as naked-grain. The spikes of ma-

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ternal varieties are castrated before they begin to head and then left without isolation for subsequent open wind pollination.

In 1952, in competitive variety testing, the F_2 and F_3 seed obtained from intervarietal crossing were seeded for verification (see table 1 on p. 106).

The data cited show that the hybrid seed of F_2 obtained from intervarietal crossing in 1950 produced a yield above standard and seed of better quality. These seeds were subjected to thermal disinfection and in 1953-1954 [Begin p.106] they were reproduced in seed growing nurseries as a basis for future hybrid elites.

The seed of the F_3 generation obtained from an intervarietal crossing in 1949 were rejected because they proved no better than ordinary seed either in productivity or in quality of grain.

Table 1.

RESULTS OF COMPETITIVE VARIETY TESTING OF BARLEY SEED OBTAINED FROM INTERVARIETAL CROSSING

Name of variety	Yield (in c per ha)	Vegetative period (in days)	Weight per 1000 grains (in gm)	Test Weight (in gm)
Omskii 13709 - standard	9.8	70	37.2	588
Omskii 13709 from intervariatel crossing of F_2	11.8	70	38.4	624
Omskii 13709 from intervarietal crossing of F_3	9.6	70	37.2	597

Modern genetics have established that in open wind pollination, the progeny, as a rule, reproduces the characteristics primarily of the materinal plant. This was first established in cross-pollinating plants by: G. A. Babadzhanian - in maize, I. A. Glushchenko - in buckwheat, A. A. Avakian - in rye.

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In our intervarietal crossings, too, the maternal type of heredity predominates in barley.

In 1950, we found in the progeny obtained from intervarietal crossing one hybrid plant with two-rowed-intermediate spikes, such as usually occur in the first generation as a result of crossing two-rowed forms with multiple-rowed forms (fig. 2).

To ascertain the hybrid character of this plant, the seed it produced were seeded the following year on a separate test plot. In the second hybrid generation it was observed that a segregation into at least five groups took place: Pallidum - 20 plants; two-rowed-intermediate hulled type - 26 plants; Mutans - 28; two-rowed-intermediate naked-grain type - 1; and Tseleste [Celeste (?)] - 1 plant (fig. 3).

The presence of naked-grain forms in the progeny indicates that the maternal variety Omskii 13709 had been fertilized by the pollen of the Tseleste variety, which is quite possible since the Tulun Tseleste 633 variety was among the blend of varieties that surrounded the maternal form. [Begin p.107].

In view of the facts connected with the appearance of hybrid plants in intervarietal crossing of barleys, mention should be made of spontaneous hybrids.

Published data on the possibility of cross-pollination and the appearance of natural hybrids in barley under Siberian conditions are not available. We have observed open flowering and the presence of hybrid forms more than once in barley plantings in a collection nursery. These were, however, isolated cases. In 1950, in a seed-production planting of the Omskii 10664 variety which belongs to the Pallidum type, we discovered a

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considerable quantity of hybrid plants which amounted to 1.2%. The spikes of these plants were of the two-rowed intermediate type which occur in F_1 when two-rowed varieties are crossed with multiple-rowed ones (fig. 4). A mechanical contamination ~~introduction of seeds~~ is here out of the question, since there were no varieties with such a spike in the laboratory plantings. In addition, careful certification is conducted annually in seed-growing nurseries and similar admixtures had not been observed in previous years. These plants could be nothing else [Begin p.8] but the first hybrid generation of a spontaneous crossing of a year ago.

In the preceding year of 1949, the Omskii 10664 variety had been seeded alongside of the two-rowed Vitiaz' variety which commenced heading on June 25th - five days earlier than the Omskii 10664 variety. At the time the latter was heading - July 1 - there could have been sufficiently ripe pollen of the Vitiaz' variety, and the direction and velocity of the wind at that time permit the assumption that fertilization of the flowers of some Omskii 10664 spikes by this pollen was entirely possible. The progeny of 136 hybrid plants, sorted as an admixture to the Omskii 10664 variety, were seeded the following year, 1951, on separate test plots to verify their hybrid character.

Fig. 3. Natural (spontaneous) hybridization

On all test plots, without any exception, it was observed that a segregation [rasshcheplenie] of the spike type was taking place. The plants could be devided into four groups; two groups had spikes similar to those in the parents (multiple-rowed - Pallidum varieties, two-rowed - Nutans varieties) and two intermediate groups: two-rowed intermediate - with a spike closely related to the two-rowed type, and multiple-rowed intermediate - with a spike approaching the multiple-rowed type (fig. 5).

Fig. 4. F_1 hybrid plant

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The plants of all progenies were analysed as to type of the spike and the number of plants in each group was computed. [Begin p.110]

Fig. 5. Hybrids of F_2: 1 - Pallidum; 2 - multiple-rowed intermediate; 3 - two-rowed intermediate; 4 - Nutans.

In F_2 there proved to be 262 Nutans plants, 387 Pallidum, 458 two-rowed intermediate and 178 multiple-rowed intermediate.

The data cited show that:

1) the plants that had been discovered were actually hybrids and

2) that they produce in the progeny different plants of the spike type, while the principal Pallidum group [Begin p.111] which conforms to the maternal variety amounts to no more than 1/3 of all plants and about 2/3 of the admixture.

The following year, 1952, we seeded for checking representatives of all four groups from the segregated families on separate test plots. The plants which belonged to the Pallidum and Nutans varieties proved constant, but the plants the spike of which was of the intermediate type segregated once more into the same four groups.

The facts described indicate that, under our conditions, the appearance of natural hybrids from wind pollination is entirely possible. This circumstance must be taken into consideration in seed production work when barley varieties are grown in seed production nurseries.

Fig. 6. F_1 h3/50 (VIR 17348 x Omskii 13709)

NEW FORMATIONS IN CROSSING BARLEY

In the year 1950 two barley forms were crossed. The maternal form was a sample from the VIR collection 17348 which had a multiple-rowed, completely awnless spike with a naked grain, and the paternal form -

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Omskii 13709 variety which belonged to the Nutans type, i.e. it had a two-rowed awny spike with a hulled grain.

In 1951, the plants of F_1 had two-rowed spikes with a hulled grain and furcation instead of awns. Thus, /Begin p.112] there appeared a new characteristic - furcation - which neither parent had had (fig. 6).

Fig. 7. F_2 h3/50 (17348 x Omskii 13709) hulled and naked-grained.

In 1952, a second generation was grown from this crossing, and here, at least 9 different forms were observed. In F_2 hulled and naked-grained forms were observed and both groups included plants that were: two-rowed awned, two-rowed furcated, multiple-rowed with short awns on the center grain rows, multiple-rowed awnless, as well as multiple-rowed hulled, and awnless with furcation rudiments instead of awns (fig. 7).

Thus, many new forms appeared in F_2 which resembled neither parent.

Back in 1951, when furcated forms appeared in F_2, there arose the question as to where the furcation had come from, if there had been no sign of it in either parent? This question was answered in 1952. That year, under conditions of a severe drought, sprouts of the maternal form - VIR 17348 - appeared [Begin p.113] considerably later and the further development of the plants was completed almost a month later than was usual, and later than the development of other varieties. Thus, for instance, heading of this form was noted on July 28, while in the Omskii 13709 variety it occurs on July 4. Under the changed conditions the spikes of sample No. 17348 had different morphological characteristics than in 1951, namely, poorly developed furcation.

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PRODUCTION OF BARLEY SEED AND LATE FALL SEEDING

In the last two years barley seed was grown from two regionalized varieties developed at SibNIIZkhoz: Omskii 13709 and Omskii 10664.

In 1954, the Omskii 10664 variety was removed from the Omsk Oblast as a result of its marked shortcomings: susceptibility to smut, brittleness of the stem and inferior quality of grain.

At present seed are grown only of one variety - Omskii 13709.

The seed-growing scheme is the usual one, 4 sections.

Methodology of work: individual selection of the best spikes and growing of the progeny in a seed nursery and in a selection nursery.

Intervarietal crossing mentioned above and late fall seeding are also practiced.

Late fall seeding has been conducted annually ever since 1948. The varieties seeded were Omskii 10664, Omskii 13709, Abrek (Omskii 6164), Evropeum [Europeum] 353/133 and Viner. Seeding was usually conducted in the first half of October with a view of having the seed enter winter dormancy when it is ready to germinate or in the seedling stage.

Some years seeding was conducted twice. Thus, for instance, in the fall of 1948, barley was seeded on the 12th and 28th of October, yet no difference was noted in the development of plants seeded on these varying dates either in the fall or spring.

Barley was seeded with a horse-drawn disk seeder on the stubble of spring wheat; the seeding rate was 4.5 million grains per hectare. Before seeding, the seeds were mixed with factory-made granular superphosphate at the rate of 1 centners of granules per hectare.

In late fall seeding, barley, in most cases, was in poor condition when spring arrived. The 1951 crop was an exception.

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In 1951, late fall seeding was carried out on October 11. [Begin p.114]. The regionalized variety used for seeding was Omskii 10664 which in 1950 had been severely infected by smut (10%).

Barley was seeded upon stubble at the rate of 185 kg per hectare. Before seeding, the seed were mixed with 1 centner of granular superphosphate and they were buried properly at a 3-4 cm depth with a disk seeder. The stubble was about 20 cm high.

Before the soil froze on October 23, the seed were swollen, individual grains were ready to germinate.

The barley overwintered well and in the spring it had a normal, dense stand. Waxy maturity was noted on June 24, and by June 30 the barley had already been harvested. The yield was 6.4 centners per hectare. The yield of late fall seeding was relatively high under conditions of the 1952 severe drought.

Smut infection in late fall seeding remained within the range of 0.55%; thus, it decreased approximately 18 times compared with the initial seed, yet for the production of elites, these seed still were inadequate. It must be noted that in the 1952 yield, the initial portion of the seed of the Omskii 10664 variety was absolutely free from smut when seeded conventionally in the spring after thermal disinfection. These data indicate that thermal disinfection is a more effective method in the control of barley smut than late winter seeding.

In 1953, seed of the Omskii 10664 variety from the 1952 yield, obtained in late fall seeding, as well as in the conventional spring seeding, were planted in competitive variety testing. The seed from late fall planting exceeded the yield of conventional seed planted in the spring by 1.3 centners per hectare (9.2 instead of 7.9 centners per ha); no difference in the quality of the seed or in the length of the vegetative period was

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In the fall of 1952 (October 15), the seed of the Omskii 10664 variety, which had experienced one late fall seeding that had been intended to free them fully from smut, was seeded late once more.

This variety was seeded in late fall simultaneously with the Omskii 13709 and Abrek (Omskii 6164) barleys. This seeding was to serve as a beginning of the conversion of spring barley varieties into winter varieties according to Academician T. D. Lysenko's method.

To achieve definitely a conversion of spring varieties into winter varieties, Academician T. D. Lysenko recommends that seed, that had been through one late fall seeding, be planted at an earlier date in the fall. We seeded the Omskii 10664 variety, which had been seeded in late fall once before, in 3 shifts: on the 10th, 15th and 22nd of September. For comparison, we simultaneously planted seed of the same variety obtained from conventional spring seeding.

Germination was good and, as a result of favorable October weather, autumn conditions had a chance to exert their influence upon the plants. However, during the 1952-53 winter the September fall seedings were completely destroyed, and on the late fall October seedings only single plants were saved.

Late fall crops of Omskii 13709 and Omskii 10664 varieties seeded on October 16, 1953 were also nearly totally destroyed in the winter of 1953-54.

Intervarietal crossings and late fall seeding practiced in seed growing produce positive results some years in raising productivity and the quality of seed and, in addition, late fall seeding decreases smut infection. Nonetheless, barley seeded in the late fall survives until spring only in favorable years.

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SELECTION AND PRODUCTION OF OATS SEED

A series of oats varieties has been developed by the method of individual selection from local Siberian specimens. Of these the Omskii [Omsk] 6922 variety has been regionalized in the second zone (Aleisk Foot-Hill Steppe) of the Altai Territory. This variety was included in State variety tests in the year 1937.

The Omsk 6922 variety belongs to the Aurea type and is characterized by the following morphological characteristics.

It is an erect plant. The panicle is unilateral; spikelets have two grains. The grain, which is closely related to the Leitevitskii type, is awnless, has an even back, tapers off [sbegaiushchee] gradually at the top, has a bright yellow coloring, is small, and the weight of its glumes [plenchatost'] is high.

The base of the lower grain is neither naked or has a few hairs.

The fundamental distinction of the given variety from other, similar varieties is pubescence of the leaf sheath.

As regards the vegetative period, this variety matures two days earlier than the Zolotoi Dozhd' [Golden Rain] variety.

In the year 1954, as in previous years, competitive testing of oats varieties developed by SibNIIZKhoza [Siberian Scientific-Research Institute of Grain Economy] was conducted so as to compare them with the best varieties of other selection stations. The Pobeda [Victory] variety was regionalized as the standard.

In point of productivity, first place was held by the standard variety, in most cases, and the second place by the regionalized variety - Zolotoi Dozhd'.

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The best of the SibNIIZkhoza varieties proved to be Omskii 19260 (Aurea type) develped by the method of individual selection from the specimen obtained from Oirotia [probably Oirot Autonomous Province].

The data on the competitive testing of this variety at SibNIIZkhoza for the last five years (1950-1954) are as follows:

Oats variety	Yield (in c per ha)	Vegetative period (in days)	Weight per 1000 grains (in gm)	Test weight (in gm)
Omskii 19260	20.6	68	31.7	459
Pobeda (Victory)	20.3	71	35.2	487

The data cited show that the productivity of the Omskii 19260 variety is almost equivalent to the yield of the standard variety Pobeda.

The advantages of the Omskii 19260 variety are: lodging resistance of straw and a low degree of smut infection.

Apart from individual selection of oats, the method of hybridization is used in the process of selection work. To develop varieties that mature sufficiently early and are productive at the same time, the laboratory crosses late maturing varieties of the Pobeda [Victory] type with varieties that ripen earlier.

These crossings have produced a series of lines which are being tested in preliminary and competitive variety tests.

The line 5h4 of Aurea developed by crossing the Omskii 6922 Aurea variety with the Omskii 3861 Mutika variety was tested for three years (1952-1954) in competitive variety tests conducted by SibNIIZkhoza. The following are the testing results (see table on page 117).

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Oats varieties	Yield (in c per ha)	Vegetative period (in days)	Weight per 1000 grains (in gm)	Test weight (in gm)
5h4 Aurea (Omskii 6922 x Omskii 3861)	11.0	66	30.6	442
Pobeda	10.5	68	35.7	464

In the course of three exceptionally dry years, the 5h4 Aurea line, the productivity of which was practically the same as that of the standard variety, proved to be somewhat earlier maturing, and its susceptibility to smut was reduced by twice.

Seed-growing work is being conducted for the purpose of obtaining improved seed of the regionalized varieties of Pobeda and Zolotoi Dozhd'. The basic working methods are - intra-varietal improvement selection, inter-varietal crossings and late fall seeding.

Late fall seeding of oats improves the quality of seed, increases their productivity and frees them of smut. They are, however, rarely successful.

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[Agrotechnics for high yields of barley and oats].

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(In Russian)

BARLEY AND OATS -
VALUABLE FORAGE-GRAIN CROPS

Oats and barley are widely distributed in our country as forage grain crops. In cropping area, oats surpasses other grain crops in the non-chernozem belt, the central chernozem oblasts, in Siberia and in the Far East. In the Ukrainian SSR, oats are seeded to a lesser extent than barley, besides, the basic oats area is located in the more humid forest-steppe and in wooded regions.

In the steppe regions of the Ukraine oats occupy a small area. This is explained by the fact that oats do not thrive under arid steppe conditions. However, experiments of scientific institutes and practice of leading kolkhozes and sovkhozes have demonstrated that even in regions of the steppe zone in the Ukraine, oats are capable of producing yields no lower than those of barley, but reven higher.

Thus, at the experimental stations in the fields of the Ukrainian Scientific-Research Institute of Grain Economy, situated in the Ukrainian steppe oblasts, the average yield of oats for 1946-1952 surpassed the yield of barley by 2.6 centners per hectare.

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Barley crops are found throughout the Soviet Union. It is seeded in regions of the far North and South. It is cultivated even in mountain regions up to 3000 meters above sea level. Such wide distribution of the barley crop is explained by its many varieties [Begin p.4] which are adapted to different natural conditions.

The largest cropping areas of barley are distributed in the Ukraine, the Krasnodar Territory and in the Rostov Oblast. Among spring grain crops, barley holds first place in cropping area in the extreme north - the Archangel'sk Oblast, in southern regions - the Crimea and the Kirgiz SSR. The short vegetative period of barley determines this circumstance. In the extreme south barley ripens before the dry winds set in, and in the extreme north it attains maturity under conditions of a short summer. Under good tillage barley and oats produce high yields of grain. Thus, in 1947, on the "Novyi mir [New World]" Kolkhoz, Staro-Oskol'sk District, Kursk Oblast, the yield of barley was 37 centners per hectare. In the year 1950, on the imeni Khrushchev Kolkhoz, Dmitrovsk District, Moscow Oblast, the yield of oats amounted to 35.6 centners per hectare, and on the Dmitrovsk variety test plot - to 45.3 centners.

In 1951, the imeni Stalin Kolkhoz, Kurganin District, Krasnodar Territory grew 31.6 centners per hectare [59.7 bu/acre] of barley on an area of 96 hectares, and the imeni Stalin Sovkhoz in the same Territory grew 33.4 centners [62.4 bu/acre]. On the Novobykov Sovkhoz, Chernigov Oblast, the yield of oats in 1950 was 33 centners per hectare [92 bu/acre].

High yields of barley and oats are obtained by kolkhozes in the southern districts of the Ukrainian SSR. Thus, in 1952, the sovkhoz "Peremozhets" [one who perseveres] Akimov District, Zaporozhe Oblast, grew 34 centner [per ha] of barley on an area of 500 hectares, and the Kolkhoz imeni Stalin,

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Piatikhatsk District, Dnepropetrovsk Oblast, grew 42.2 centners [per ha] of oats on an area of 45 hectares.

The grain of barley and oats possess a high-grade forage quality. The grain of oats contain less starch than those of barley, but they have a larger content of fats. Oats are especially useful as forage for animals maintained for breeding.

According to calculations of the Ukrainian Scientific-Research Institute of Grain Economy, 100 kilograms of barley grain are equivalent to 112.4 feed units. One hundred kilograms of barley grain fed to swine increases the weight of an animal up to 20 kilograms. Consequently, a yield of 25 centners per hectare of barley grain [46.7 bu/acre] used to fatten swine insures a live weight of 500 kilograms. [Begin p.5]

The stems of barley and oats also possess good forage qualities, especially when they are mowed early for hay.

The merits of barley and oats are not limited to their forage value. Barley grains are used to prepare pearl barley and barley flour; the grains of barley are the basic raw material for the beer brewing industry. The readily digestible grains of oats are used for the production of different kinds of groats and other food products.

The February-March Plenum of the TsK KPSS [Central Committee of the Communist Party of the Soviet Union] noted the neglect in the production of forage grain crops, including barley and oats, and proposed that the cropping area under these crops be expanded and their productivity increased.

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CHARACTERISTICS OF THE GROWTH AND DEVELOPMENT OF BARLEY AND OATS

In cultivating barley and oats, usually the same agrotechnics are applied, yet the plants of these crops have their own biological characterists that need to be taken into account when they are grown.

Barley. When the seed [caryopsis] of barley germinates, it absorbs water in amounts equivalent to nearly half its weight; the seeds germinate at relatively low temperatures, 1--3 degrees of heat. Barley plants survive easily temporary temperatures below zero.

Barley is distinguished by a short vegetative period, from 85-100 days. In the steppe regions of the Ukraine, the duration of this period (from germination until full maturity) is some years reduced to 72-67 days.

A barley grain germinates with five to seven radicles. These embryonic, or initial, roots penetrate the soil readily and by tillering time they have reached a depth of about 50 centimeters. The subterranean stem forms the tillering node, from which nodal or secondary roots develop on the 18-20th day after germination. In vigor of the root system, barley is inferior to oats.

Barley plants form a great mass of roots in the soil horizon in which fertilizers are placed. When fertilizers are applied under the plow, more roots form at this depth yet in row placement of fertilizers, they form in the uppermost layer of the soil. [Begin p.6].

Barley plants tiller well and, as a result, they shade the soil surface and inhibit the growth of weeds. Four and five stems form when tillering is good, yet not all of them form spikes. In dry years, especially in southern regions, one barley plant produces 1--1.5 spikes on the average. With superior tillage, however, it is possible to increase tillering of barley and to increase the number of spikes.

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Fig. 1. Roots of a barley plant: a - tillering node; b - nodal (secondary) roots; c - remainder of seed; d - initial (embryonic) roots.

On each projection of the spike stem of a barley plant there forms not only one spikelet, but three of them. Under the usual conditions of cultivation, all spikelets are single flowered [Begin p.7]. If all three florets develop and produce grain, the spike becomes a multiple row spike. Only one, the central spikelet develops on two-row barley. Since multiple row barleys have a larger protein content they are used largely for forage and food products. Two-row barleys have a large, uniform grain with a small protein content and are used primarily by the beer brewing industry.

The chemical composition of the barley grain depends to a considerable degree on soil and climatic conditions. In northern and northwestern regions where the climate is more humid, the barley grain contains more starch and less protein. In southern regions where the soil is rich in nitrogen and less humid, the grain of barley contains less starch and more protein.

The quality of the grain depends also on the varietal characteristics of the barley. Thus, the naked-grain barley varieties have a larger protein content than the hulled types.

Barley does not thrive on acid soils, and swamp and peat soils are entirely unsuitable for it. Barley produces a good yield on tenacious, argillaceous soils.

Barley consumes less soil moisture and is more drought resistant than oats.

<u>OATS.</u> Swelling of oat seed requires more water than barley seed - about 65 percent of the weight of the grain. The seed [caryopsis] of oats

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germinates at 3-4 degrees of heat. Young oat plants can stand spring frosts.

The duration of the vegetative period of oats is 98-110 days. The short vegetative period and modest heat requirements render oats a suitable crop for cultivation far up north. Nonetheless, oats are not cultivated in regions of the Extreme North since they ripen later than barley.

Oats are also inferior to barley when moved to southern regions. This is explained by the fact that oats are more sensitive to high temperatures, less resistant to air dryness and more susceptible to the destructive effect of blasting than barley.

Deficiency of water in the soil during pollen formation, before the flowering of oats, causes sterility in the flowers and reduces the yield of grain. In a dry, hot summer [Begin p.8] oat plants ripen prematurely and as a result, the grain turns out sickly and light-weight. At the same time, oats, compared to other spring grain crops, consume soil moisture less economically and survive better excessive soil moisture.

The roots of oats penetrate deeper soil horizons than barley roots. Secondary or nodal roots appear soon after germination and develop rapidly. The root system of oats has the capacity to assimilate poorly available nutritive elements.

Oats are less demanding with regard to soil than barley. They are cultivated successfully on different soils - heavy clayey, swampy and peat soils. Under good agrotechnics and with sufficient moisture, oats develop well on sandy-loam soils. Oats are less sensitive to soil acidity than other grain crops, hence it is the first crop to be seeded in newly reclaimed soils in the non-chernozem belt. Solonets soils are less suitable for oats.

The more cultivated types of oats have panicles with two to three florets in the spikelet which under normal condition of growth and development, form two-three grains. The first or lowest grain in the spikelet

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develops best, and is richer in composition. This grain possesses the best seeding properties.

The properties of oat grains vary under different cultivation conditions. In the southern and south-eastern regions of the country, oat grains contain more protein than in the western, north-western and central regions. Big differences in protein content in the grain are observed in different oat varieties.

Conditions of growth exert substantial influence upon the seeding properties of the seed. Thus, it has been established at the Kinel'sk Experimental station that under south-eastern conditions, early spring seeding of oats is conducive to production of seed with higher yielding properties. Late seeding is deterimental to specific properties in oat seed of the new crop.

Thus, barley and oat plants require appropriate conditions of external environment for their normal growth and development. These conditions depend to a considerable degree on the use of proper tillage methods. The productivity of barley and oats can be increased sharply by improving the cultivation conditions of these forage grain crops.
[Begin p.9].

THE PLACE OF BARLEY AND OATS IN CROP ROTATIONS

The best forerunners for barley and oat crops are row crops and winter crops. Considering the barley makes greater demands on conditions of growth than do oats, it is given preferential treatment with regard to preceding crops when fields are assigned.

In regions of the White Russian SSR, barley usually follows potatoes, in crops rotations. High yields of barley seeded after potatoes are ob-

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tained on kolkhozes of the Leningrad, Vologda and Arkhangel'sk Oblasts.

In beet growing regions one of the best crops to precede barley is the sugar beet. By allocating barley to follow sugar beets, the imeni Chkalov Kolkhoz, Uvniansk District, Kursk Oblast, harvested in 1947, 33 centners of grain per hectare. On the Talovsk Variety Test Plot (Voronezh Oblast') where forage grain crops are seeded after row crops, the yield of barley, for the years 1938-1946, averaged 30.5 centners per hectare, and the yield of oats - 26.7 centners. In experiments conducted at the Mirinov Selection Station, barley seeded after sugar beets on podzolized chernozems produced a yield of 29.8 centners per hectare.

Under conditions of the Ukrainian steppe, the best preceding crops for barley are maize, potatoes, melons, legume crops and winter wheat on fallow. Barley seeded after sunflowers produces meager results. By seeding barley after maize, the imeni Stalin Kolkhoz, Piatikhatsk District, Dnepropetrovsk Oblast, harvested 28.1 centners of grain per hectare.

Considering that oats are less demanding with respect to soil and, being leafy, inhibit weeds successfully, they often are allocated to the last position in the crop rotation. Oats, as a fallow crop, are seeded also intermixed with legumes. Good predecessors of oats are peas and other legume crops which enrich the soil with nitrogen.

By seeding oats after row crops that had been fertilized, the "Novaia Pobeda [New Victory] Kolkhoz, Kingiseppskii District, Leningrad Oblast, obtained a yield of 32 centners per hectare of grain on a seed plot. [Begin p.10].

High yields of oats are obtained when they are seeded after winter wheat. Thus, on the Mozhaisk Variety Test Plot (Moscow Oblast), oats seeded after winter wheat produced in 1952 a yield of 30 centners per hectare.

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In regions in which spring wheat is seeded on fallow, this crop is the predecessor of barley and oats in generally adopted crop rotations. Thus, forage grain crops are seeded as the second crop after fallow. Such is the allocation of barley and oats, for instance, on the "Sibiriak" Sovkhoz, Irkutsk Oblast, which obtains high yields of all grain crops.

In the southern regions of the country, particularly in the Ukraine, oats are allocated after the same preceding crop as barley. Thus, in 1952, the Kolkhoz imeni Kaganovich, Kamensko-Dnepropetrovsk District, Zaporozhe Oblast, produced 29.4 centners per hectare of oats followed a maize crop. The imeni Zhdanov Kolkhoz, Rostov District, Zaporozhe Oblast, which had seeded this crop after potatoes, obtained a yield of oats of 27 centners per hectare. A high yield of oats - 30 centners per hectare - was harvested by the kolkhoz imeni Zhdanov, Genichesk District, Kherson Oblast, where the preceding crop had been winter wheat after fallow.

The examples cited indicate that allocation of barley and oats after good predecessors is of great importance in producing high yields of grain of these crops. However, to evaluate a preceding crop correctly, it is important to know not only the crop that had been seeded, but also the agrotechnics used in the preceding year on the field concerned. It would be wrong, for instance, to assume that potatoes are the best predecessor for oats and barley in all cases. Under inferior agrotechnics, ptoatoes will stop being a good predecessor.

Correspondingly, a less suitable predecessor crop of barley and oats can be turned into a good one with an appropriate system of agrotechnical methods.

Since the general adoption of the method of hill-check planting of row crops on kolkhozes and sovkhozes, which makes mechanized tending in two directions possible, weeds on inter-tilled fields can be fully eliminated and

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the fields can be entirely adequate for the production of high yields of forage grain crops. [Begin p.11].

TILLAGE

Preparation of the seedbed for barley and oats consists of the basic, late fall and of pre-seeding tillage.

If barley and oats are to be seeded after row crops, then basic tillage includes deep, late fall plowing immediately after the row crop has been harvested. If, however, barley and oats are to be seeded upon stubble predecessors, then late fall plowing must be preceded by shallow plowing of the stubble [lushchenie].

Shallow plowing of stubble. After a harvest of cereals, the soil surface is left unshaded and is heated through by direct solar rays causing evaporation of a great deal of moisture. To prevent drying of the soil, shallow plowing of stubble is conducted simultaneously with the harvesting by means of an implement attached to the combine or following the harvesting. The friable surface layer of the soil formed by shallow plowing retards the drying of the lower soil layers. Even if moisture from the lower layers does rise, it stops at the friable surface layer. In addition, the soil layer made friable by shallow plowing absorbs atmospheric precipitation better. Hence, the tillable layer on a plowed field takes up moisture well and crumbles readily during the next late autumn flowing.

Shallow plowing cuts weed stubble and the dispersed seed of weeds are buried in the soil. This creates conditions for the germination of weeds which later are destroyed by plowing. According to data of the Moscow Agricultural Academy imeni K. A. Timiriazev, timely shallow plowing of stubble of the previous crop had reduced weeds of spring crops by 80

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percent; and according to data of the Sinel'nikov Selection-Experimental Station (Ukrainian SSR) by 64 percent.

On plots overrun by quack grass, shallow plowing is conducted with a two-furrow disc tiller - lengthwise and cross-wise at the depth at which the basic mass of the quack grass rhizomes has settled, i.e. at 10--12 centimeters. In so doing, the roots are cut into very small pieces. When sprouts of quack grass ("dyer's broom) appear, the field is plowed with plows having frontal attachments (coulters?) [predplushniki]. Pieces of rhizome land at the bottom of the furrow and are covered by a thick layer of soil. Shoots of the rhizomes are destroyed. [Begin p.12].

The effectiveness of this method of quack grass control is obvious from the following results of an experiment conducted by the Soil-Agronomic Station imeni V. R. Wil'iams on a kolkhoz in the Krasnopoliansk District, Moscow Oblast. In late fall plowing without preliminary discing, the number of quack grass stems on one square meter was 478 before plowing and 257 stems before harvesting - yet with preliminary discing - 636 and 12 stems respectively.

Shallow plowing is very important also in the control of root shoot weeds [korne otpryskovye sorniaki], particularly, of thistle which is widely distributed in southern regions.

Shallow plowing of stubble is an efficient means of destroying agricultural pests found in the upper layers of soil or on stubble residue. Besides, timely shallow plowing makes fall plowing possible at a smaller consumption of tractor power [tiagovye usiliia]. The agrotechnical effectiveness of timely fall plowing of stubble is apparent from the following data on the calculation of the productivity of forage grain crops. At the Kherson Experimental Station, late fall plowing of stubble was responsible for an increase in barley yield averaging, for 15 years, 2 centners per hectare.

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On the "Novaia Zhizn'" Kolkhoz, Krivoi Rog District, Rostov Oblast, barley obtained after fall tillage without shallow plowing amounted to 25.5 centners per hectare, yet in late fall tillage with shallow plowing, it amounted to 29.4 centners. According to data of a number of experimental institutes in the non-chernozem belt, the increase in the yield of oats due to timely shallow plowing of stubble was from 1.9 up to 3.4 centners per hectare.

Fall plowing. Fall plowing renders the tillable horizon friable, destroys weeds which have succeeded in growing after shallow plowing, and clears the soil of pests and causal agents of disease. Fall plowing makes it possible to accomplish seeding work early in the spring and within a short space of time.

Fall plowing must be carries out early, because it provides a greater accumulation and retention of soil moisture which is especially important in southern and south-eastern regions.

Adequate soil moisture creates favorable conditions for the activity of soil microorganisms. If fall plowing is carried out early, microorganisms have time to enrich the soil with elements of plant nutrition and thus to improve conditions for the growth of spring crops. [Begin p.13]. In an experiment conducted at the North-Caucasus Experimental Station, the yield of barley on a field plowed on August 29, was 3.4 centners per hectare higher than after late plowing (at the end of October). Consumption of soil moisture on an a 1 hectare area amounted to 2,877 tons in the first instance, and to 3,360 tons in the second. This difference in yield and in water consumption is explained by the fact that in early fall tillage the soil has a large accumulation of nutritive substances readily available to barley plants.

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On the "Paris Commune" Kolkhoz, Bogorodsk District, Gor'kii Oblast, the yield of oats seeded after early fall [plowing] was 6.6 centners per hectare higher than of oats seeded in the late fall.

It is essential to clear the field of stubble residue so as to be able to carry out fall plowing at an early date. Early fall tillage plays an important role in the control of weeds among crops. It was established in experiments conducted at the Sinel'nikov Selection-Experimental Station (Ukrainian SSR) that 136 weeds per square meter had been found in grain crops seeded after August tillage, yet after November plowing there were 326. According to data of the Azov-Black-Sea Institute of Mechanization and Electrification of Agriculture (Rostov Oblast), there were 6 thistle stems on one square meter of spring crops seeded after August plowing, yet when fall plowing was conducted in October - there were 29.

Depth of plowing is of great importance. Soil moisture accumulates larger amounts and is better conserved after deep plowing; this contributes to an increase in yield. Deepening of the tillable layer with the simultaneous application of fertilizers is especially important in increasing the yield in regions in which structurally poor soils and sod-podzolic soils predominate. However, deep plowing directly before spring grain crops is, as a rule not practiced in crop rotations. Barley and oats do, however, produce a larger yield in instances in which deep plowing was carried out with their preceding crops. Thus, in the Drabovsk experimental field (Ukrainian SSR) the yield of oats had increased by 2.8 centners per hectare when plowing under the preceding crop had been carried out at a depth of 32-35 centimeters. On the podzolized soils of the Chartoriisk Experimental Field (Zhitomir Oblast), the yield of barley seeded after beets, [Begin p.14] under which plowing had been conducted at a 27 centi-

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meter depth, had increased by 1.8 centners per hectare.

In experiments conducted on the Korostensk Experimental Field on moderately podsolized sandy loam, plowing at the depth of 33-35 centimeters (with the application of fertilizers) under beets, had produced a three-year average increase of 8.6 centners per hectare in the yield of barley, the following crop. At the Bezenchuk Experimental Station, deep plowi ng under the preceding crop had increased the yield of oats by 2.4 centners per hectare. Consequently, timely shallow plowing of stubble, early fall plowing and deepening of the tillable layer are important factors in increasing the yield of barley and oats.

T. S. Mal'tsev, laureate of the Stalin prize, established in his experiments that under conditions of the Kurgansk Oblast, deep plowing under grain crops should not be carried out every year, but once every 4-5 years, and then with plows without mold boards [bezotval'nymi plugami]. In the following years, discing, instead of plowing, should be carried out on the fields. This method of tillage should be tried out in every zone of the Soviet Union.

<u>Fall tillage</u>. Presently adopted fall tillage in which the surface of the field is left uneven over the winter cannot be considered as adequate for all regions of the country. Thus, in regions with a long, dry autumn, ridges on a field do not facilitate the accumulation of moisture during the fall; moreover, the soil, in such cases, may lose the last vestiges of moisture. In a winter with a scanty snow-fall, ridges do not serve as a means of snow retention, and in the spring they dry up rapidly and deeply before harrowing is begun.

Professor P. A. Kostychev, at the end of the past century, recommended that harrowing of plowland snowless regions, particularly in the Crimea, be carried out in the fall so as to safeguard the soil from

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drying out during the winter. The inadmissibility of leaving plowland in ridges over the winter in regions of scanty snow in Eastern Siberia was pointed out by scientific workers of the Baiandaisk Experimental Field back in 1926. Some experimental institutes in the Southern Ukraine had in prewar years arroved at the conclusion that fall harrowing was disadvantageous.

At present, due to the increase of technical equipment and advance agricultural practices, there arises the question [Begin p. 15] as to whether methods of fall plowing ought not to be changed in the individual regions.

Thus, experiments conducted in the Chitinsk Oblast indicate that under conditions of Eastern Transbaikal it is necessary to level the surface of fields after fall plowing. On the leading seed-growing sovkhos, "Sibiriak", Irkutsk Oblast, harrowing is done concomitantly with fall plowing to improve conservation of soil moisture.

In reclaiming wastelands under conditions of Kazakhstan, harrowing is carried out concomitantly with fall plowing.

Experiments conducted on kolkhozes and sovkhozes in the Stalingrad Oblast have demonstrated that a field plowed early and harrowed at the same time insures higher yields. Thus, on the "Kotluban'" Sovkhoz, Gorodishchensk District, Stalingrad Oblast, the increase in the yield of barley due to fall harrowing amounted to 3.6 centners per hectare on an area of 626 hectares.

On the Starobel'sk" Sovkhoz, Voroshilovgrad Oblast, and on the Sovkhoz imeni Artem in the same oblast, fall harrowing was responsible for a 3 to 7 centners per hectare increase in the yield of barley and oats. On the Melitopol Sovkhoz No. 10, Zaporozh'e Oblast, on an area of 90 hectares harrowed in the fall, the yield of barley in 1952 was 34 centners

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per hectare, yet without harrowing it was 28 centners, and the yield of oats on an area of 60 hectares was 30 and 27 centners per hectare respectively.

Thus, smoothing down the field surface at the time it is plowed is of great importance to production in regions of the extreme South and South-East and also in the regions of Eastern Siberia. Extensive agronomic testing of this supplementary method fall plowing essential.

Retention of snow and of thawing water. An important means in the accumulation of large reserves of soil moisture in arid regions is the retention of snow and thawing water in fields allocated for spring crops including barley and oats. A good snow cover in winter time safeguards the soil against deep freezing. Thus, in areas in which soil had been kept warm by snow during the winter, the activity of soil microorganisms begins earlier in the spring. As a result, conditions for plant nutrition are improved and the yield is increased. [Begin p.16].

Different methods are used for snow retention: piling up snow ridges with packing snow-plows [snegopakh-uplotnitel'] placing shields, sunflower stems, reeds and other tall plants on the fields.

The best aids in retaining thawing water in the fields are bands of packed snow across the slopes. Such bands of snow are formed by the passing of loaded sleds covered underneath with battens [tes]. On fall plow-land it is best to use a packing snow-plow which, in passing, rakes up snow from a wide strip and presses it into a narrow ridge. In the spring, the snow piles check the flow of thawing water on the slopes. and areas denuded by the passing snow-plow thaw out more rapidly. Thus, the thawed out places contribute to better absorption of thawing waters by the soil.

Preseeding preparation of the seedbed. This type of tillage is begun with early-spring harrowing of the field. In southern and south-

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eastern regions, delay in harrowing leads to great losses of moisture. In the Ukrainian steppe, one hectare of an unharrowed field loses 80-100 tons of water in one spring day. Therefore, early-spring harrowing of a field must be finished in 1-2 days. To break up the soil more efficiently, harrowing is carried out with heavy harrows in 1-2 operations, depending on the condition of the soil.

Under oats and barley crops, immediately after the harrowing, an additional soil stirring of field is carried out at right angles to the plowing to the depth at which the seed is to be placed, with simultaneous harrowing. This practice assists the penetration of air into the upper soil layers, the warming up of the soil and also the leveling out of the field surface. Subsequently, the level surface of the field facilitates the work of harvesting machines. Experiments conducted on the kolkhozes imeni Karl Marx, Genichesk District, Kherson Oblast, have demonstrated that pre-seeding cultivation of the field had increased the yield of barley by 2.5--3 centners per hectare.

In regions of the non-chernozem belt, on clayey and loamy soils, replowing is practiced instead of cultivation. These heavy soils, plowed in the fall are so compact by spring that cultivation and harrowing are insufficient. Under these conditions, replowing in the spring at a depth of 12--14 centimeters insures better loosening of the soil, as a result of which seed are planted more evenly. [Begin p.17].

The experiments have, however, demonstrated that loosening with a multiple plow [orudiia] without mold-boards can be substituted successfully for replowing. The Experimental Station for Agronomy, Moscow Agricultural Academy imeni K. A. Timiriazev has established that such working of the soil at a 15-17 centimeter depth, compared to replowing, increases the yield of oats by 2.4 centners per hectare.

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Spring replowing under spring crops is to be practiced only when it becomes necessary to plow under manure in the spring, or when a fall-plowed field is overrun by weeds.

In preseeding tillage, especially with deep working of the field in the spring, rolling is used in dry and windy springs. Rolled out, level soil insures a uniform depth of the seedbed. Besides, this agro-technical method helps to draw moisture from the lower soil layers to the seed and thus increases their field germination.

On the "Forward to Socialism" Kolkhoz, Sverdlov Oblast, as a result of preseeding rolling of the soil, the 1948 yield of barley was increased by 1.5 centners per hectare. On the Bilimbaev variety test plot in the same oblast, the yield of oats was increased up to 3 centners per hectare as a result of rolling before to seeding. Preseeding rolling must, however, be applied carefully to prevent excessive compacting of the soil.

FERTILIZATION

Kolkhozes and sovkhozes apply fertilizers primarily to technical, vegetable and subsistence crops; barley and oat plantings usually get only the after effect of these fertilizers. However, placing fertilizers directly under forage grain crops in all regions in which they are cultivated will provide the largest possible increases in the yield of grain.

Manure exerts a positive effect several years after its introduction in the soil. Barley and oats utilize the residual effect of manure fertilizer better than other spring crops. At the Shelonsk Experimental Station (Pskov Oblast), the increase in the yield of oats from the residual of manure fertilizer amounted to 4 centners per hectare. In experiments of the Ural Zonal Experimental Station, the increase in the yield of oats planted

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as the second crop after the application of manure [Begin p.18] reached 6.1 centners per hectare. On the Erastov Experimental Field where manure was applied twice to crop rotations (under winter wheat and under maize), the increase in the yield of barley amounted to 8.9 centners per hectare.

Considering the high response of barley and oats to the residual of manure, leading kolkhozes and sovkhozes allocate these crops to those fields in which fertilizer had been applied to the preceding crop. Thus, in 1950 the "Svoboda" kolkhoz, Iaroslav Oblast, obtained 30 centners per hectare of oats after row crops on a plot that had been fertilized with manure. The "Zhovten'" Kolkhoz, Toumakov District, Dnepropetrovsk Oblast, gathered a 42 centners per hectare yield of barley on an area that had been fertilized with 16 tons of manure and 1.5 centners of superphosphate per hectare one year before this crop was seeded.

In the northern regions of the non-chernozem belt where barley is grown for food, manure is applied directly to this crop. In the Karelo-Finnish SSR, Arkhangel'sk and Vologda Oblasts, the yield of spring grain crops increased up to 8 centners per hectare from manure applied at the rate of 40 tons per hectare.

Under conditions of the Ukrainian steppe, manure applied directly to the barley crop also insures a large increase in yield. Thus, on the Erastov experimental field, application of 20 tons of manure per hectare to barley as a 4 year average, increased the yield of grain 6.1 centners per hectare.

Mineral fertilizers. High yields of barley and oats are obtained by applying mineral fertilizers directly to the given crops, as well as by fertilizing their preceding crops. On the Kolkhoz imeni Stalin, Dzerzhinsk District, Minsk Oblast, application of nitrogen, phosphorus and potassium at the rate of 45 kolograms per hectare to loess-like, medium

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podzolic loam increased the yield of barley from 27.2 centners to 33.6 centners per hectare. The increase in yield derived from fertilizing solely with nitrogen and potassium amounted to 2.9 centners per hectare.

On loam and slightly leached out chernozem soils, the largest increase in the yield of barley is obtained from nitrogen fertilizers, on peat-bog - from phosphorus.

Mineral fertilizers contribute to an increase in yield on ordinary chernozems of the Ukrainian steppe zone as well. [Begin p.19]. Thus, in experiments conducted at the Sinel'nikov Selection-Experimental Station, the 3-year average of the yield of barley derived from the application of 45 kg of nitrogen, phosphorus and potassium increased by 6.2 centners per hectare.

Young barley plants on chernozem soils particularly require phosphorus nutrition.

In growing barley and oats on drained peat-bog, it is necessary to apply fertilizers containing copper. In experiments conducted by the Institute of Soil Science and Agriculture of the Academy of Sciences, Latvian SSR, application of pyrite cinders (waste from production of sulfurous acid containing copper) to swampy gley-sod and sandy soils in maritime regions produced an increase in the yield of oats ranging from 4 to 9 centners per hectare, and in the yield of barley from 2-3 centners.

It is known that barley does not thrive on acid soils. Here good results are obtained from liming. Lime corrects the acid reaction of the soil. On the "Iulenurme" Sovkhoz (Estonian SSR), the yield of barley seeded on acid soils as the third crop after liming increased by 5.5 centners per hectare and amounted to 34.2 centners.

Solonets soils must be treated with gypsum. The best results are obtained when gypsum is applied together with manure. On the "Chervonit

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Selianin" Kolkhoz, Kalanchak District, Kherson Oblast, introduction of gypsum and manure deep under the plow produced a 5.8 centners per hectare increase in the yield of barley.

Gypsum treatment of solonets soils increases the effectiveness of mineral fertilizers.

The best results are obtained from mineral fertilizers when they are applied together with organic fertilizers - manure, composts and peat.

Row application of fertilizers. In row application, the fertilizers are not intermixed with a large mass of soil, but are placed near the roots of young plants thus enabling them to utilize the nutritive substances to better advantage. The preference of row application of fertilizers to grain crops concerns primarily superphosphate. This is explained by the fact that phosphoric acid of pulverized superphosphate broadcast during plowing or cultivation is intermixed with a large bulk of soil and, chemical compounds, result that no longer are readily assimilable by plants. Plants can utilize no more than 10-20 percent of this type of fertilizer. If, however, superphosphate is applied to in narrow bands a considerably larger portion of its nutritive substances becomes available to plants.

At the Mironovsk State Selection Station (Kiev Oblast), the increase in the yield of barley due to row application of fertilizer amounted to 6 centners per hectare on the average. In addition, an increase was observed in the absolute weight of the grain: on unfertilized plots, the weight per 1,000 grains was 46.2 g, with row fertilizing it was 52.2 g. In experiments of the Ukrainian Scientific-Research Institute of Grain Economy, a small quantity of fertilizers (nitrogen and phosphorus at the rate of 11 kolograms and potassium at 15 kolograms) applied to small rows on ordinary chernozems produced a 4.1 centners per hectare increase in the

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yield of barley.

Granular fertilizers. For the purpose of improving the nutrition of plant roots and for more economical utilization of mineral fertilizers, Soviet agronomic science has suggested utilizing these fertilizers in granular form. When granular superphosphate is used, there forms in the soil around the granule zone with a large content of phosphorus readily available to plants. It is particularly important to apply granular superphosphate to rows concurrently with the planting of the seed. On the Kolkhoz imeni Stalin, Dzerzhinsk District, Minsk Oblast, application of 20 kilograms of granular superphosphate to small rows together with the seed was responsible for an increase of 7.8 centners per hectare in the yield of barley and for a yield amounting to 37.9 centners.

Granular fertilizers can be applied with an ordinary seeder in the furrow, at the same time that the grain crops are seeded; this makes fertilizing of grain plantings possible even if a farm does not have a special combination seeder (seeder with fertilizer attachment).

When granular fertilizers are introduced into the soil along with the seed with an ordinary seeder, then the two should be mixed prior to seeding. If seed are mixed with fertilizers earlier, it may cause a decrease in seed germination. Hence, granular fertilizers should be mixed with seed directly before they are seeded in the soil. [Begin p.21].

Barley plants fertilized in rows with small doses of granular fertilizers have a chance to feed abundantly on readily available nutritive elements from the first days of their growth and development. Such plants develop more rapidly a vigorous root system and a large mass of leaves and shoots, they suffer less from spring frosts, develop heading and mature earlier, and produce grain with a higher absolute weight.

Fig. 2. Root system of barley: left - roots of a fertilized plant; right - roots of an unfertilized

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plant. There is a large concentration of roots at the place where fertilizers are applied at a depth of 20 centimeters.

[Begin p.22]

Among local fertilizers poultry droppings are applied to spring grain crops during the harrowing of a fall-plowed field (before preseeding cultivation) at the rate of 5-6 centners per hectare. Ashes are best applied in the fall under the plow at the rate of 4-6 centners per hectare.

On sandy and podzolic soils of the non-chernozem belt good results are obtained when green manure is applied. This type of fertilizer enriches the soil with organic substances, improves conditions for plant growth and is instrumental in increasing the yield.

Bacterial fertilizers. Enrichment of the soil with beneficial microorganisms is achieved by the use of manure, composts and other organic fertilizers. Along with these, much importance is attached to the use of bacterial fertilizers.

For the purpose of improving nitrogen nutrition of plants, a bacterial fertilizer named azotobacterin or azotogen, which contains the Azotobacter bacteria, is applied. These bacteria are introduced in the soil together with the seed. They assimilate atmospheric nitrogen at the rate of 30-60 kilograms of nitrogen per hectare within a year. Introducing such a quantity of nitrogen into the soil in the form of fertilizers would require one to one-and-a-half centners of ammonium nitrate or 5--6 tons of manure per hectare.

Treatment of 150 kilograms of seed requires one bottle of azotobacterin. Directions for its use are indicated in the enclosure to the preparation.

After applying azotobacterin to barley, the Kolkhoz "Vpered",

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Borisoglеb District, Iaroslav Oblast, obtained a 5 centners per hectare increase in yield. On the Kolkhozes imeni Stalin and "Boevye tempy", Viaznikov District, Vladimir Oblast, the increase in the yield of oats after applying azotobacterin was 3--3.5 centners per hectare.

Azotobacterin can be used successfully in the non-chernozem belt as well as in the chernozem.

The bacterial fertilizer "AMB" is applied to peat and sod-podzolic soils. This preparation is used intermixed with well pulverized peat and limestone (or ashes). The mixture is prepared earlier - a month before it is applied. The "AMB" fertilizer is used in the spring under preseeding cultivation.

Recently a new type of bacterial fertilizer - phosphorobacterin - has been applied. This preparation contains bacteria [Begin p.25] which are capable of converting phosphorus found in the soil from an unavailable form to one that is available to plants and readily assimilable. Introduction of phosphorobacterin into the soil along with the seed improves phosphatic plant nutrition since its rich reserves abound in chernozem soil. Phosphorobacterin used in experiments conducted at the Krasnograd Experimental-Selection Station produced an increase in the yield of balry amounting to 3 centners per hectare. Numerous experiments conducted under conditions of the Ukrainian SSR have established that the yield of oats increased by 1.3 centners per hectare when phosphorobacterin was applied to chernozem soils.

Phosphorobacterin comes in liquid and in dry forms. Fifty grams of liquid phosphorobacterin are needed for an amount of seed required for one hectare, but 350 grams when it is used in dry form. Directions for its use are indicated in the enclosure to the preparation.

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Seed disinfected with formalin must be aired before they are treated with bacteria. Disinfection of seed with granosan should be carried out 30 days before they are treated with bacterial fertilizers.

PREPARATION OF SEED FOR SEEDING

High-grade, selected seed that are adequately prepared for seeding form the foundation of a high yield. It is very important that seed grown on highly productive seed plots be kept for seeding. If seed material has a high moisture content, then it must be dried until it is brought down to the normal 14 percent of moisture before it is accepted for storage.

Seed material is cleaned with a [combination] fanning mill sorter, the "Triumph" sorter, and then with a seed separator so as to sort them according to form and size.

Large seed are best for seeding.

It is very important to sort the seed of multiple-row barley and especially of oats to achieve uniformity. The larger, first seed of oats can be separated adequately from the second seed by appropriate adjustment of the separator. The operation involves rearranging the cylindrical sieve in the separator from the second sieve onto the first.

If the complex grain-cleaning machines of VIM and OS-1 which combine the work of a winnower, sorter and separator are available, [Begin p.24] then it is best to clean seed material with these machines.

Seed material must be entirely free from any admixture and it must possess sufficiently high germination and germination energy. Seeds that have been cleaned and put in seeding condition, are examined three times during their storage period by the seed-control laboratory: the first time -

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before October, the second - in January-February and the third - 15--20 days before seeding.

Seed material of barley and oats must meet the following requirements.

Seeding Condition of Barley and Oats Seed

Class	Seed of basic crop (in percentages)	Waste of basic crop and admixtures (in percentages)	Not exceeding		Germination not under (in percentages)
			Seed of other plants (number per kg)	Including seed of weeds (number per kg)	
I	99.0	1.0	10	5	95
II	98.5	1.5	100	25	95
III	97.0	3.0	300	100	90

Seeding of large, uniform seeds will produce even germination and ensure uniform development and maturation of the plants. Well filled out, heavy-weight and well developed seed possess of higher yielding qualities. Experiments conducted at the Field Experimental Station of the Moscow Agricultural Academy imeni K. A. Timiriazev have demonstrated that seeding of the very largest seed increases the yield of barley by 4.5 centners per hectare, and of oats by 4.6 centners, compared with yields produced by unsorted seed. Similar results were obtained in experiments conducted by the White Russian State Selection Station.

Leading farms seed large, heavy seed. Thus, the Kolkhoz imeni Kirov, Solonianak District, Dnepropetrovsk Oblast, which harvests annually high yields of oats (36.2--36.6 centners per hectare), planted in 1953 seed with an absolute weight of 33.4 grams. [Begin p.25]. On the Kolkhoz imeni Malenkov, Geniohevsk District, Kherson Oblast, the absolute weight of barley seed was 44.6 grams.

For the purpose of obtaining high yields of barley and oats, it is

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necessary to disinfect seed [of the respective crops] against covered smut [Ustilago hordei] and loose smut [Ustilago avenae]. The kernels of plants attacked by covered smut contains a black pasty mass. This mass consists of extremely small smut spores. In threshing, the smut infected grains split and the spores stick to the surface of the healthy grains.

To prevent covered smut infection of plants, the seed grain must be treated with a disinfectant before seeding. Treatment is carried out by a dry, semidry or wet method. In disinfecting barley against covered smut and oats against covered and loose smut by the dry method, granosan (NIUIF-2 /Scientific-Research Institute of Fertilizers and Insectofungicides/) is applied at the rate of: 1.5 kilograms per ton of barley seed, and 1.5--2 kilograms per ton of oat seed. The seeds are to be disinfected no more than 3 days before they are seeded. Especially good results are obtained from barley seed treated with granosan.

Dry treatments are carried out with the PSP-0.5 and Pu-1 machines or in specially designed barrels. The seed are mixed with the disinfectant in a drum within the machine or barrel for 5 minutes at a velocity of 40-50 revolutions per minute. Since a granosan preparation is a poisonous substance, safety measures must be observed while the work is being done.

For semidry disinfection, a formalin solution prepared directly before using is applied; it consists of one part of 40-percent formalin and 80 parts of water. One ton of barley seed requires 15 liters of solution, and one ton of the seed of oats - 32 liters. The seed grains are wetted with the solution indicated, then arranged into piles, covered with canvas and allowed to soak for 4 hours. After this process, the grain is shoveled over and then seeded. Semidry disinfection must not be carried out earlier than 5 days before seeding.

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The disinfectant used in wet treatment consists of one part of a 40-percent formalin in 300 parts of water. The seed are moistened with the solution and then left for 2 hours under a canvas cover. Then they are dried beneath an awning (in a shady place). Disinfected seed must not be dried in the sun, since this might cause a decrease in their germination. [Begin p.26] Wet treatment of seed must not be carried out earlier than 2--3 days before seeding.

Dry treatment of barley and oat seed has advantages over semidry and wet treatment. In the first place, dry treatment is simpler than other methods of disinfection; in the second place, dry treatment eliminates the danger of new smut infection.

In vernalizing barley and oat seed, wet treatment is usually applied with a formalin solution. Treatment of seed with granosan is carried out a month before vernalization.

Barley plants are attacked also by loose smut. When this occurs, the ear together with the grain turn into a black, powdery mass which is easily dispersed by the wind. The spores of loose smut penetrate into the florets of healthy ears at the time of flowering, germinate on the stigma of the pistil and penetrate the young seed. Here the fungus of loose smut is in a state of dormancy. The grain infected by loose smut does not differ externally from the healthy ones. Such a grain produces a plant that appears healthy and normal externally, and disease is discovered only at the time of heading when an infected spike emerges instead of a healthy one.

To free barley seed of loose smut, thermal treatments are applied: the seed is heated in water at a temperature of 45 degrees [C] for 3 hours, or at a temperature of 47 degrees for 2 hours, and then dried.

In thermal disinfection of seed, the ZK-0.5 and ZKP-1 locomotives or forage-steamers [kormozaparniki] are utilized.

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Application of this method on the "Vpered" Kolkhoz, Pereshchepinsk District, Dnepropetrovsk Oblast, has shown that barley crops can be entirely freed from loose smut. On an area of 74 hectares cropped to heated seed, the yield of grain was 22 centners per hectare, and on an area of 85 hectares cropped to unheated seed, it was 17 centners. This method can be used in treating seed immediately before seeding, as well as in advance.

Vernalization of seed is of special importance. The practice of vernalization reduces somewhat the length of the vegetative period, permits seeding of barley and oats in more northerly regions and increases the yield of grain. [Begin p.27].

The technics of vernalizing barley and oat seed consist of the following. Thirty five liters of water are used for 100 kilograms of seed; wetting is carried out in three operations. After the third wetting the seeds are kept for 15--20 hours in a pile at a temperature of 10-12 degrees. Then the temperature is reduced to 2--5 degrees by turning the seed with a shovel or by reducing the thickness of the grain layer. At this temperature the seed are kept for period of 10-14 days. In the event seeding time sets in before the vernalization period has expired, then the seeds are planted before they are completely vernalized. If vernalized seed begins to germinate vigorously, then the pile is raked out into a thin layer so as to allow them to dry.

The most important method of insuring increased field germination of seed, especially in regions in which cereals ripen in the second half of summer, is air-heat warming [vozdushno-teplovoi obogrev] of seed. Such heating is carried out as follows: In the spring, as warm, sunny days set in, the seed grains taken from winter storage, is spread over canvasses, or over solidly tamped areas of ground, in thin 5--7 centimeter layers and are turned with wooden rakes or shovels 3--4 times a day. Warming seed in the

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sun takes 3--5 days. It must be finished 10--15 days before seeding.

Very good results are obtained from air-heat warming of seed in regions of Siberia and the Urals, also in regions of the northern and central oblasts of the European part of the Soviet Union. On the "Pamiat' Lenina" K Kolkhoz, Topkinsk District, Kemerov Oblast, the germination of barley seed, after air-heat warmed, had increased from 45 up to 90 percent, and germination energy from 25 up to 82 percent. On the Kolkhoz "Pobeda", Tikhvinsk District, Leningrad Oblast, the yield of barley, due to solar warming of seed, had increased by 2.4 centners per hectare. On the "Sibiriak" Kolkhoz, Irkutsk Oblast, germination of oats, as a result of natural air-heat warming of seed, had increased from 56 up to 96 percent.

SEEDING OF BARLEY AND OATS

Timely, even germination of barley and oats is insured by proper seeding on the best agrotechnical dates. Barley and oats seed must be placed in a moist, compact seedbed and [Begin p.28] covered with a friable, moist, sufficiently warm layer of soil. Barley and oat sprouts usually appear on the 6--8th day after seeding.

In the proper seeding of barley and oats, much importance is attached to dates and method of seeding, rate of seeding, and depth at which the seed are deposited in the soil.

Dates of seeding. In regions of the European part of the Soviet Union, early spring sowing is of decisive importance in obtaining high yields of barley and oats. This is particularly important in the arid regions of the South-East, the Ukraine, Northern Caucasus and in the central chernozem oblasts. Delay in sowing leads to a sharp decrease in crop yield and quality.

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When seeding of oats on the Vladimirsk Experimental Field was delayed for 20 days, the yield decreased by 8.1 centners per hectare. Experiments conducted in regions of the Western Ukraine, particularly near the City of Lutska, have demonstrated that barley seeded on the 2nd of April, produced a yield of 31.9 centners per hectare, yet when seeded on April 15, i.e. 13 days later, the yield was 28.5 centners. Delayed seeding reduces also the quality of the grain, and its absolute weight and non-farinaceous material decrease.

In southern, arid regions the surface soil dries out rapidly in springtime. This creates unfavorable conditions for the growth and development of plants when sowing is conducted late: sproutsare sparse, more of them are injured by pests, particularly by the Swedish fly, tillering in plants is poor, and, as a result of this, their productivity is low.

However, in the arid regions of Siberia and in the northern oblasts of Kazakhstan, yields of oats are higher in relatively late sowing than in early. Thus, on the Kolkhoz imeni Molotov, Sretensk District, Chitinsk Oblast, oats seeded on 20--25th of April produced a yield of 11.5 centners per hectare, yet when seeded on May 10th - it was 13 centners, when seeded on May 25th - 17 centners, and when seeded on June 10th - 22 centners.

Approximately the same results were obtained in experiments conducted on the Sretensk Experimental Field (Chitinsk Oblast). The seed-growing sovkhos "Sibiriak" (Irkutsk Oblast) obtained the best yields of oats when seeding had been carried out between the 23rd and the 30th of May. In the regions indicated above, oats and barley, if sown too early, are planted in cold, unheated soil and therefore germinate late and produce [Begin p.29] sparse sprouts, leading to a sharp decrease in yields.

<u>Seeding Methods.</u> In recent years, new, progressive grain crop seeding

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methods, such as narrow-row and crosswise seeding have received fairly widespread adoption. Narrow-row seeding is carried out with a special narrow-row seeder or with a remodeled seeder; and transverse seeding - with a conventional seed drill in two directions lengthwise and crosswise or diagonally. In narrow-row seeding, with a 7.5 centimeter interrow, and in crosswise seeding, the plants are distributed more uniformly over an area than in conventional row-seeding. Hence each plant has a better opportunity of utilizing soil moisture, nutritive substances and sun light which contribute toward an increase in yield.

Fig. 5. Arrangement of rows and distribution of seed: 1 - uniform row seeding; 2 - crosswise seeding; 3.- narrow-row seeding.

It has been established experimentally and by production practice that density of the plant stand increases and weeds decrease when crosswise and narrow-row seeding methods are used.

On the Kolkhozes "Krasnoe Znamia" and "Krasnyi Vostok", Zagorsk District, Moscow Oblast, the increased yield of oats obtained from crosswise seeding amounted to 3--7 centners per hectare. On the Kolkhoz imeni Zhdanov, Teplinsk District, Vinnitsa Oblast, the yield of barley obtained as a result of crosswise seeding [Begin p.30] surpassed that of row seeding by 4--6 centners per hectare. On the "Sibiriak" Sovkhoz, Irkutsk Oblast, crosswise seeding of oats increased its yield by 3--4 centners per hectare.

Crosswise seeding is instrumental in increasing the effectiveness of other agrotechnical practices. Thus, in experiments of the Mironovsk State Selection Station (Kiev Oblast), the yield of barley, after the application of fertilizers to small rows in crosswise seeding, surpassed the yield obtained from conventional row seeding by 5.5--5.8 centners per hectare.

The narrow-row method, too, has big advantages over conventional row seeding. On the Kolkhoz imeni V. V. Dokuchaev (Voronezh Oblast), the in-

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crease in the yield of barley upon narrow-row seeding amounted to 7 centners per hectare on an area of 80 hectares.

Special importance is attached to the crosswise method in seeding vernalized oats, since their full seeding quota cannot be planted at one time.

The crosswise seeding method has, however, its shortcomings. This method requires twice as much time for seeding, since the seeder must cross the field in two directions besides, the second crossing of the seeder may cause excessive intermixing of the moist soil with its dried out upper layer at the depth at which the seed are placed. Therefore, the established seeding dates must not be protracted when the crosswise method is used. It is essential that narrow-row seeding of barley and oats be adopted on all farms. Seeding by this method is accomplished best with the SB-48 seeder.

Seeding rates. To obtain high yields of barley and oats, it is very important to establish correct seeding rates. Seeding rates that are too high will produce an excessively condensed grass stand leading to inhibition of the plants and a reduction in their productivity. Yet, seeding rates that are too low will be responsible for a thin grass stand. In such a case the crops will be overrun by weeds. Apart from this, sparse distribution of barley and oat plants provokes increased tillering, as a result of which the grains mature at different times and their yield decreases. Conditions favorable for the growth and development of plants and high yields can be provided only by proper seeding rates. [Begin p.31].

In establishing correct seeding rates, it is necessary to take into account the prevalence of moisture and nutritive substances in the soil, the quality of seed and their size, and also the seeding method. In regions with sufficient precipitation the seeding rates of barley and oats

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should be higher than in regions with moisture deficiency. When the narrow-row and crosswise methods are used, the rate of seeding should be increased (by 15-20 percent).

In the individual regions, the follwing approximate seeding rates are used for barley and oats.

Regions	Seeding rates (in centners per hectare)	
	Oats	Barley
Siberia and the Far East	1.6--2.0	1.6--2.0
Non-Chernozem Belt	2.0--2.3	1.9--2.2
Central Chernozem Oblasts	1.5--1.7	1.7--1.8
South Eastern Oblasts	1.1--1.3	1.0--1.4
Ukrainian SSR	1.1--1.6	1.2--1.7
Northern Caucasus	1.3--1.5	1.3--1.6

It is, however, necessary to establish these average rates precisely on every farm in relation to local conditions, besides, the seeding rates may vary for the individual situations. On the more fertile and sufficiently moist (lowland) locations, a higher seeding rate should be used. On sloping land with a partially leached out tillable layer, the seeding rate should be somewhat decreased. In the production practice of many farms, calculation of seeding rates by the number of grains per unit area is adopted. Thus, on the district seed-growing farm "Smychka", Riazansk Oblast, it has been established experimentally that the best seeding rate for oats on local fields is 5.5 million grains per hectare.

In order to convert the seeding rate into the quantity of seed per kilogram, it must be calculated as follows: the seeding rate in millions of seed per hectare is to be multiplied by the absolute weight of the seed and divided by the coefficient for economic fitness. Let us presume that the adopted seeding rate amounts to 6 million seed per hectare; the absolute weight of the seed is 33 grams; economic fitness - 96 percent. In this case the weight

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of the seeding rate per hectare will be:

$$\frac{100 \times 6 \times 33}{96} = 206.3 \text{ (kilograms)}$$

[Begin p.52]. In southern arid and semiarid regions it is desirable to change and to establish seeding rates accurately every year, in relation to soil moisture reserves at the time of seeding. Thus, the Ukrainian Scientific-Research Institute of Grain Economy established for the northern part of the Ukrainian Steppe as follows: in years in which fall-winter precipitation had drenched the soil at a depth of no less than 100 centimeter, the normal seeding rate for barley should be 5 million seconditional seeds per hectare. If, however, moisture had penetrated the soil no deeper than 50-70 centimeters by the time of seeding, then the seeding rate must be reduced to 4 million seeds per hectare. An analegous precise definition of the seeding rate for spring grain crops is used on kolkhozes in the Rostov Oblast.

On farms growing high yields of barley and oats, arbitrary reductions of seeding rates are not permitted.

Seeding depth. Seed must be sown at deep enought to reach the humid layer of the soil. On heavy, loamy, moist soils the seed are covered with a shallow layer of soil, but on light sandy soils, deficient in moisture, they are placed deeper.

In establishing the depth at which seeds are to be sown, their size must be taken into consideration. Small seeds are sown with a more shallow soil layer than large seed.

In regions of the non-chernozem belt, barley seeds are sown at a depth of 3--4 centimeters, but in more arid regions - in the South and South-East - at a depth of 6--7 centimeters. The depth for oat seed has been established in the non-chernozem belt at 3--5 centimeters, depending on the character of

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the soil. On drained swamps the best results are obtained at a 2--3 centimenter depth.

In southern steppe regions, the upper soil layer is likely to dry at the seeding depth before the seed germinate, if their covering is shallow. If sprouts do appear under these conditions, then the tillering node in plants is too high and secondary roots frequently fail to form. The plants are left with one set of roots, the initial (embryonic) ones. In such plants productivity is low.

When seed are covered deeper, the tillering node is covered deeper and insures a normal development of secondary roots.

Fig. 4. Tractor equipment used in spring sowing of grain crops.

[Begin p. 54]. Experiments of the Ukrainian Scientific-Research Institute of Grain Economy have established that in southern steppe regions, especially in dry and windy springs, the seed of barley and of large-grain oats must be planted at a depth of 8 centimeters. The Kolkhoz imeni Molotov, Melitopol District, Zaporozh'e Oblast, had in the dry spring of 1952, had harvested 38 centners per hectare of barley on an area of 90 hectares, and 31.3 centners of oats on an area of 32 hectare. This kolkhoz had sown its barley and oats at a depth of 7-8 centimeters.

Larger seed should be sown deep.

TENDING OF CROPS

After the tractor and the seeder have passed over the soil surface it still is not entirely level. In order to level out the soil surface and to pulverize it so as to prevent excessive drying, the seeder must be followed by a light harrow hooked onto it.

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Should individual seeds be left on the soil surface after the seeding, they are covered by the subsequent harrowing. This practice contributes toward more uniform germination.

In experiments of the Rostov Experimental Station, post-seeding harrowing provided a 2 centners per hectare increase in the yield of barley. In humid springs, in which cold weather persists and sprouts appear late, there arises the need of harrowing crops on heavy soils, if the surface of the fields is flooded after a rainfall. In such cases, however, harrowing can be carried out only on condition that young shoots be not injured. If the shoot is not longer than the seed, harrowing can be carried out. If, however, the shoots increase in size, there arises the danger of injury by the harrow. For loosening of a flooded and compressed soil surface, it is best to use a rotary hoe. Aeration provides air for the young shoots and thus strengthens their growth and accelerates the emergence of sprouts. [Begin p.455].

In regions deficient in precipitation, and also in other regions in which dry springs are responsible for the rapid drying out of the upper soil layer, it is recommended that rolling be carried out after seeding. As the soil is pressed down with a roller, the movement of moisture to the seed is increased. This practice accelerates the appearance of more sprouts of uniform size. Thus, at the Odessa Experimental Station, under conditions of the dry spring of 1947, 200 plant sprouts appeared on one square meter cropped to barley when rolling had been carried out, yet without rolling there were 104.

On fields rolled after seeding, sprouts appear earlier, formation of secondary (nodal) roots is accelerated, all stages of growth and development set in more rapidly and, by the time of harvesting, there is a great density of spike-bearing stems. On the "Zhovten'" Kolkhoz, Tomakov District,

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Dnepropetrovsk Oblast, on a plot on which postseeding rolling had been carried out in 1952, the number of barley heads was 693 per square meter at the time of harvesting. On this plot, the kolkhoz gathered 42 centners of grain per hectare.

Rolling after seeding is especially important on fields on which the soil had not settled, because this type of soil dries out very rapidly in the spring.

It must, however, be kept in mind that the roller can produce a negative effect, if it is not followed immediately by a light harrow stirring up the upper soil layer. This operation protects the soil against excessive drying.

A corrugated roller produces the best results. In regions with sufficient precipitation, rolling need not be applied, especially to heavy soils. With such soils rolling contributes toward flooding of the soil after rains, and the formation of a crust on its surface.

One practice with barley and oats crops is harrowing when the soil surface is compacted and flooded after rains. Harrowing should be carried out after the plants have taken root, usually in the stage of tillering. The Station of Agronomy of the Moscow Agricultural Academy imeni K. A. Timiriazev has established that harrowing of oats at the beginning of tillering increases the grain yield by 3 centners per hectare. According to data of the Odessa Experimental Station, harrowing in the period of tillering, under conditions of the Ukrainian steppe, increases the yield of barley by 1 centner per hectare.

[Begin p.36] It must be noted that only those crops in which the seed are planted at a depth of no less than 6-7 centimeters can be harrowed. Harrowing of crops with sparse stand is inadmissible. It is wrong to harrow when the soil is parched or when it is too humid and pasty.

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Harrowing must be done with light harrows in a single trip across harrow rows, and with crosswise seeding - in a slanting direction to the rows.

To remove the crust, it is best to use a rotary hoe.

Barley and oats crops must be clean of weeds. This is achieved primarily by the proper basic treatment of the soil and by preseeding treatment. Thus, on the Kolkhoz imeni Chkalov, Novomoskovsk District, Dnepropetrovsk Oblast, no weeds are found in the fields thanks to systematic, timely and expert handling of the soil. In recent years the kolkhoz has been producing barley and oat yields of no less than 24 centners per hectare from the entire cropped area.

If, however, weeds do appear among the crops, they must be destroyed in order to create better germination conditions for barley and oats plants. It is best to carry out weeding during the tillering period, but not later than at the beginning of booting. To keep weeds from growing anew, they must be pulled out by the roots. Perennial weeds with vigorous roots that penetrate deep into the soil (thistle, smartweed, milkwort) should be cut down as deep as possible.

Lately a new method had been used in the control of weeds which involves spraying with special chemical substances - herbicides. Herbicides inhibit the growth of dicotyledons which include most weeds, when they are deposited on the leafy surface of these plants. Some weeds are completely destroyed by herbicide action. Weeds, such as ragweed and Canada thistle are eliminated most effectively when sprayed with herbicides.

Monocotyledons which embrace all cereals, including barley and oats, are not affected by these substances.

The preparations used in spraying are 2M-4Kh or 2,4-DU. They are applied at the rate of 0.5--1.5 kilograms of herbicide dissolved in water

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per hectare.

The best results are obtained when spraying is conducted in the phase of tillering or at the beginning of booting when the crop plants are not as yet covered with an abundance of leaves [Begin p.57] and drops of the solution fall in large quantities upon the surface of the weeds. If it happens to rain after the spraying, then the effectiveness of chemical weeding is decreased, because the herbicide is washed off the weeds.

At the Smolensk State Selection Station, the yield of oats increased by 6 centners per hectare as a result of chemical treatment. On kolkhozes of the Michurin and Nikiforov Districts, Tambov Oblast, the increase in the yield of oats obtained as a result of such chemical treatment of crops amounted to 3.5 centners per hectare. Spraying of oat crops with herbicides on the Kolkhoz "Zhovtneva peremoga", Shchorsk District, Dnepropetrovsk Oblast, was responsible for a 4 centner per hectare increase in yield.

In instances in which legume grasses are seeded under the cover of barley and oats, chemical weeding should be omitted, because these grasses fall within the class of dicotyledon plants that are injured by herbicides.

Chemical weed control reduces sharply the consumption of man power used in weeding crops.

In growing crops, it is necessary to provide for pest control.

In the southern regions of the country, primarily in the steppes, grain crops are injured by the Swedish and Hessian flies, aphids, cereal saw flies, cereal ground beetles, false wireworms, and also by susliks [rodents]; in regions of the non-chernozem belt - by wireworms, false wireworms, the Swedish fly and aphids. In eastern regions, where virgin lands are being reclaimed, crops are likely to be badly damaged by locusts and susliks.

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Susliks inflict heavy injuries on grain crops during their maturing. A suslik is capable of destroying up to 16 kilograms of grain during the summer. Measures for their control include the use of traps, pit-falls, poisoned bait, flooding of burrows with water, and by running them down with poisonous substances. Suslik control must be conducted on all resources simultaneously, and best in the spring, before the progeny settle down.

In the control of injurious insects, preventive measures are of greater importance than extermination. The proper sequence in crop rotations helps to avoid concentration of pests in the fields. Timely fall plowing with preliminary plowing of stubble [Begin p.38] helps to destroy a considerable portion of injurious insects and to prevent their mass reproduction.

Agrotechnical measures, which create favorable conditions for the growth and development of cultivated plants and increase their vitality, insure greater plant resistance to pests and diseases.

In the control of injurious insects, the elimination of weeds among crops and on field margins is also of great importance. Timely harvesting of the yield, without loss of crops, prevents the appearance of refuse which is the basic food of flies injurious for cereals, and of cereal aphids before sprouts of winter crops emerge.

To destroy flies in areas in which their distribution is heavy, crops are dusted with poisonous substances - DDT and benzene hexachloride. Dusting of seed is also applied so as to prevent their being injured by wireworms and false-wireworms. Lately a new poison has been developed and proposed for the dusting of seed - it is "mercurin" which includes granosan and benzene hexachloride. This preparation is designated for the control of pests as well as for the control of diseases.

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CHARACTERISTIC AGROTECHNICS ON SEED PLOTS

Varieties of barley and oats seeded in the different regions must be well adapted to local conditions and capable of providing high and stable yields. Seed of the best regionalized varieties produce a yield that exceeds ordinary seed by 20-30 per-cent on the average.

The quality of seeding material is determined not only by its germination, purity, size and uniformity, but also by conditions of cultivation. High agrotechnics used in growing seed help to improve their seeding and yielding properties. In experiments conducted at the Leningrad State Selection Station for the evaluation of seed productivity of two oat varieties (Orel [Eagle] and Rannii Belyi [Early White]), it was established that seed grown in the year 1949 with the application of fertilizers produced in 1950 plants with a better developed root-system than seed obtained from unfertilized plots. [Begin p.39]. These plants proved more productive as well.

Under south-eastern conditions, the Kinel'sk Selection Station harvested seed with higher productive qualities when oats had been seeded early. Thus, in 1947, the yield of oats (Pobeda [Victory] variety) obtained from seed that had been planted early amounted to 25.4 centners per hectare, yet from seed planted late - 19.9 centners. The high productive quality of seed acquired as a result of early seeding was retained in following generations.

At the Sinel'nikov Selection-Experimental Station (Ukrainian SSR), barley seed (Grushevskii variety) grown on a fertile plot produced a 3.9 centners per hectare increase in yield.

Hence, it is essential to create the very best conditions for plant culture. On leading kolkhozes and sovkhozes seed plots are provided with

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appropriate and timely tillage, with snowretention, fertilization and crosswise or narrow-row seeding of large seed under first rate seeding conditions.

The most fertile land is allocated for seed plots. These plots are fertilized at the first opportunity. Crops on seed plots are maintained in a state of purity and are weeded for specific and varietal purposes.

Yield grown on seed plots is carefully cleaned, seeds are brought down to a normal moisture content (not above 14 percent) before they are placed in storage. Seed material is stored in piles up to 2 meters high in bins or sacks which are placed in stacks (not more than eight sacks high and not more than two sacks in width). Steps are taken to prevent mixing of seed not only of different varieties, but of different reproduction and categories as well.

HARVESTING THE CROP

The most important conditions for proper harvest are timely accomplishment of the work within the shortest possible time.

In oat plants the grain begins to mature at the upper part of the panicle. If oats were to be harvested when the spikule in the lower part of the panicle has reached maturity, it might result in great losses, [Begin p.40] since the grains in the upper part of the panicle, which have ripened earlier and grown larger, may shatter. Therefore, oats are harvested when the panicle is three-fourths ripe. Harvesting of oats with ordinary machines should be begun earlier-- when the grains are fully ripe at the center of the panicle.

Ripening of oats in sheaves proceeds less satisfactorily than with other cereal crops. A harvest that is conducted too early leads to a loss

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of yield determined by the large quantity of green, immature grains.

Barley is harvested with combines at the beginning of full maturity, but with ordinary machines - 2--3 days earlier. Big losses of barley grains occur when they are overripe. In addition, in multiple-row barley, the heads break and are lost completely, while in two-row barley - the individual grains are shed. Big losses due to overripening occur also as a result of plant lodging. The time when barley and oats begin to ripen depends on their varietal characteristics as well as on conditions of cultivation. Thus, on southern and western slopes ripening occurs earlier than on northern and north-eastern slopes. On heavy loam soils ripening is protracted, but on sandy and sandy-loam soils it is, conversely, accelerated. Therefore, it is necessary to watch systematically the condition of barley and oat plants on every plot during the period of their ripening. Harvesting must be begun selectively, without waiting until these crops have matured on the entire field, and it must be carried out promptly. A harvest accomplished in the shortest possible time is the best means of preventing losses.

In the basic regions of barley and oats culture, harvesting of the crop is conducted primarily with combines. In order to prevent losses, stems must be cut low when harvesting. Reel fans must not strike the head. Special attention must be paid to the threshing of grain. If the grain is excessively moist then the gap between the drum and the sieve [deka] must be decreased. Combines must be equipped with grain catchers and head catchers. Thus, in the course of a day, the moisture of the plants and of the grain being harvested may change sharply and, in accordance with this, it is necessary to regulate the combine so as to achieve good threshing and to prevent mechanical injury to the grain being harvested. [Begin p.41].

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If the grain has an excessive moisture content, it must be brought down immediately to normal. For this purpose grain is cleaned of superfluous admixtures and is dried in the sun or in special driers.

Much importance is attached to timely gathering of straw and chaff so as to preserve their forage value and to free the field for timely tillage for the next crop. The straw and chaff brought from the field are stacked carefully so as to prevent spoilage of this forage while in storage.

Special attention must be paid to the harvesting of barley and oats on seed plots. Harvesting of seed plots is usually conducted when grains are completely ripe. Seeds gathered when they are fully mature possess high-grade seeding properties.

The margins of a seed-plot adjoining other crops are mowed before the seed are harvested in order to prevent mixing of grain. Harvesting and grain cleaning machines are cleaned carefully of grain residues before a seed plot is harvested.

Grain from seed plots must be turned over for storage when their moisture content is not above 14 percent. On the Melitopol Sovkhoz No. 10, Zaporozh'e Oblast, the moisture of oat grains was about 20 percent in 1952. Cleaning of grain was conducted immediately after harvesting, then the grain was dried on a specially prepared area [na toku] and taken to storerooms in a dry state.

Timely harvesting insures the gathering of the entire crop and the fulfilment of State commitments for delivery of high-quality grain on time.

Superior accomplishment of mowing, threshing and cleaning of grain on the best possible dates calls for maximum mechanization of the labor consuming processes of this work.

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THE CROP OF WINTER BARLEY

As regards winter hardiness, winter barley is in many respects inferior to winter wheat. Yet in southern regions where winter frosts are not severe, winter barley is grown successfully on the fields of kolkhozes and sovkhozes.

Crops of winter barley of more or less considerable extent are found intthe Krasnodar and Stavropol Territories, [Begin p.42] in the southern Ukraine, especially in the Crimean Oblast, in the Dagestan Autonomous SSR, and the Azerbaidzhan,Gruzinian, Turkmen and Uzbek SSR.

The lack of winter hardy varieties of winter barley is one of the basic reasons for the restricted distribution of this crop.

The grain of winter barley is distinguished by a high content of carbohydrates and a smaller quantity of protein, than the grain of the spring varieties. It is utilized for forage.

The high content of carbohydrates in the grain of winter barley is explained by the fact that the plants of this crop develop under a greater abundance of moisture and utilize fall, winter and early spring precipitation. In regions of the extreme South, this circumstance determines the greater productivity of winter barley as compared with spring barley. Thus, on the Kolkhoz imeni Stalin on the Kuban [River], the yield of winter barley in 1951 amounted to 31.2 centers per hectare and in 1952 - to 29.1 centners, while the yield of spring barley in the corresponding years amounted to 25.9 and 23.9 centners.

Winter barley completes its development earlier than spring barley and earlier than winter wheat. Under Kirgiz conditions, winter barley matures 2 1/2 weeks earlier than spring barley, in the Southern Ukraine 8--10 days earlier, attaining maturity before the summer drought sets in.

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Early harvesting makes it possible to utilize the field under stubble crops, or to prepare the seedbed earlier for the planting of winter cereals.

One of the best and more winter-hardy varieties of winter barley is Krasnodar [Krasnodarskii] 2929. This variety is regionalized in the Krasnodar Territory, Crimean Oblast and in the South of Kazakhstan. The variety Pallidum 330/2 is regionalized in the arid foothill regions of Azerbaidzhan. In regions of Central Asia winter varieties are seeded, as well as varieties capable of overwintering and suitable for fall and spring seeding.

In the last four years, a newly developed winter barley variety - Odessa [Odesskii] 17 - has been cultivated in districts of the Odessa, Kherson and Nikolaevsk Oblasts. This variety is more winter-resistant than others and rather highly productive. On eight kolkhozes of the Kherson Oblast on which winter barley was seeded alongside of spring barley in the year 1953, its yield surpassed that of spring barley by 7.4 centners per hectare.

[Begin p.48]. On nine kolkhozes in the Odessa Oblast, the yield of winter barley in 1953 exceeded the yield of spring barley by 8.7 centners per hectare. On the Kolkhoz imeni Karl Marx in the Oktiabr'skii District, Nikolaevsk Oblast, winter barley produced a yield of 38.4 centners per hectare on an area of 5 hectares in the unfavorable year of 1953; on the Sovkhoz "Ingulets", Kherson Oblast, it produced 30.4 centners [per ha] on an area of 20 hectares. The criteria cited for the new winter barley variety - Odesskii 17 - indicate its desirability for regions of the steppe zone of the Ukrainian SSR.

Winter barley is seeded after non-fallow preceding crops. Experience gained by kolkhozes of the Odessa Oblast has demonstrated that the best results are obtained when winter barley is seeded after row crops. It is

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recommended that winter barley be planted after maize the stems of which are cut at the height of 25 centimeters from the ground for snow retention. When winter barley is planted after row-crops, only preseeding tillage is carried out.

Seeding time is very important in the case of winter barley. As indicated above, winter varieties and barley varieties capable of over-wintering which are suitable for fall and spring seeding are grown in Central Asia. Late fall seeding carried out in December coincides with early spring seeding which is begun in January.

Under conditions of southern regions in the steppe zone of the Ukraine, winter barley passes the winter better and provides high yields when it accomplishes tillering adequately before wintering. Experiments conducted by the All-Union Selection-Gentics Institute have demonstrated that it is best to seed winter barley during the last ten days of September. Under Kuban conditions crops of winter barley grow successfully even when seeded in November.

According to data of the Stavropol Experimental Station of Animal Husbandry, the best seeding time for winter barley in the mountain regions of the Northern Caucasus is the middle of August.

Winter barley is seeded at a higher rate than spring barley. In the Northern Caucasus and in the Crimea, [Begin p.44] the recommended approximate seeding rate for winter barley is 160-180 kilograms per hectare, and in the Kuban - 150 kilograms.

The distribution of winter barley crops in chief regions in which it is cultivated, and also in the regions of the Ukrainian steppe zone, is to a considerable degree related to the work of selection being done for the purpose of developing winter hardy varieties of this crop.

Concomitantly with the above, winter hardiness of existing varieties

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can be increased by applying the appropriate agrotechnical practices, even if it were only preseeding application of nitrogen, phosphorus and potassium fertilizers.

Expansion of winter barley crops will contribute toward an increase in grain crop forage in the regions in which winter barley is grown

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Chepigo, S. V., and Vasiunina, N. A.

Poluchenie Mnogoatomnykh spirtov iz
nepishchevogo pastitel'nogo syr'ia.

[Production of polyatomic alcohols from
inedible raw material of plants].

Gidroliznaia i Lesokhimicheskaia
Promyshlennost', vol. 9, no. 6.
pp.3-6. 1956. 301.8 G36

Institut Organicheskoi Khimii Akademii Nauk SSSR.
[Institute of Organic Chemistry of the Academy of
Sciences USSR].

(In Russian)

The 20th Congress of the KPSS [Communist Party of the Soviet Union] has imposed the task of utilizing new kinds of inedible raw material in the production of various chemical products for which now subsistence grain, potatoes and edible fats are being used.

One means of saving edible raw material is the production of polyatomic alcohols from polysaccharides contained in plant tissues of wood and in different types of agricultural plant waste.

Polyatomic alcohols - glycols, glycerin, erythrites, pentites and hexites - contain from two to six hydroxylic groups which determines their great reactive capacity and leads to the formation of a considerable number of various products[1].

Production of polyatomic alcohols continues to grow from year to year and assumes ever greater importance, especially in connection with the development of the organic synthesis industry. Thus, for instance, general production of polyatomic alcohols in the USA has increased more than three times in the last 10 years and by now exceeds 500 thousand tons

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per year [2].

The further increase in the release of synthetic products and commodities used widely in the USSR also calls for a rapid development of the production of polyatomic alcohols.

Until recently, the increase in the production of polyatomic alcohols was due almost exclusively to the increased release of glycols and glycerin which was based on the used of ethylene and propylene-containing fractions of petroleum gases and edible fats. At present, as a result of the decreased consumption of fats for the manufacture of soap, due to the release of synthetic detergents, production of glycerin by means of splitting fats is not increasing and is even going to decrease. In the USA, the amount of glycerin obtained from fats between 1947 and 1951 has decreased by almost 35% and by now does not exceed 1/5 of the total output of polyatomic alcohols [3]. Full compensation for the decreased output of glycerin from fats, due to the production of synthetic glycerin, appears impossible for many reasons, including certain limitations of raw material resources and the use of propylene for other purposes, complicated technology, need of chemicals in large amounts (chloride, hydrogen peroxide) and others.

Diverse and ever increasing demands for polyatomic alcohols, the effort to produce them at a small cost, and the need to replace glycerin have aroused also an interest in the production of pentites and hexites, particularly of sorbite and mannite which possess a series of additional specific properties as compared with glucols.

Polyatomic alcohols - pentites (xylite, arabite etc.) and hexites (sorbite, mannite, dulcite) are sweet, crystalline substances freely soluble in water and in alcohol, and insoluble in ether. They form readily esters with mineral and organic acids. Pentites and hexites are hygroscopic,

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possess plasticizing properties and have a low freezing temperature for solutions.

A more effective method of reducing polysaccharides into polyatomic alcohols is catalytic hydrogenation, conducted for the first time by V. N. Ipat'ev in the year 1912 [4].

Stereoisomeric pentatomic alcohols, xylite and arabite, are obtained readily from xylose and arabinose

$$C_5H_{10}O_5 \xrightarrow{2H} C_5H_{12}O_5,$$

which have the normal structure of $CH_2OH - CHOH - CHOH - CHOH - CH_2OH$.

The hexatomic normal stereoisomeric alcohols sorbite, mannite and dulcite have the structure of $CH_2OH - CHOH - CHOH - CHOH - CHOH - CH_2OH$ and are obtained from glucose, mannose and galactose

$$C_6H_{12}O_6 \xrightarrow{2H} C_6H_{14}O_6$$

From fructose, a mixture of mannite and sorbite is obtained.

Pentites and hexites, particularly xylite and sorbite, equal in a number of properties the value of glycerin and are used widely in place of glycerin in the chemical, paper, textile, light and other branches of industry. Sorbite is used widely in synthesis of a number of organic substances, for instance, alkyd resins, esters, anticorrosive coverings, ascorbic acid and other products [2,3,5,6], and it is also used in the production of cellophane, paper, fabrics, artificial fiber, linoleum, adhesives, tobacco, perfume manufactures, confectionary and bakery products [7,8]. Xylite and its derivatives may also be utilized extensively in obtaining alkyd resins (xyphtals [ksiftalei]), lacquers, xyphtal drying oils [9,10] and, similar to sorbite, in the production of various commodities that are used extensively.

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Sorbite is released on a commercial scale in a number of foreign countries (USA, France, India, and Switzerland). In the USA sorbite production has increased 10 times since 1950 [6]; the annual output of sorbite and mannite has exceeded 40 thousand tons and its shows a tendency for further growth [2]. Raw materials used in the production of sorbite and mannite abroad are exclusively food products - glucose and saccharose (beet and sugar cane), the solutions of which are hydrogenised under high pressure with catalyzers being present.

In the USSR, too, edible raw material is used for commercial production of sorbite, and annual consumption, for this purpose, of crystal glucose obtained from corn starch or potatoes is very large.

The further development of the production of hexite and other polyatomic alcohols depends on discovering new, more readily available, non-critical raw material sources.

Practically unlimited and annually renewable resources of wood and plant waste of agriculture containing up to 70% of polysaccharides could serve as an important source of inedible raw material for this purpose. Hence, one of the real promising means of obtaining polyatomic alcohols is their production from polysaccharides derived in the chemical processing of plant materials by the hydrolytic method. [Begin p.4].

XYLITE AND SORBITE PRODUCTION

Research work and practical propositions for the production of polyatomic alcohols by means of chemical processing of plant tissues concern chiefly the production of xylite from pentosans of agricultural plant waste, and also [the production] of glycerin by the method of biochemical processing of hexose hydrolysates of wood.

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Production of xylite under commercial conditions was first accomplished by using the scheme suggested by E. Z. Pliushkin and improved by the workers of VNIIGS, "Giprogidroliz" and the Fergana factory.

By this scheme (fig. 1), the initial raw material - cotton husks preliminarily refined by water-acid treatment are exposed to pentose hydrolysis [11], the pentose sugars obtained are purified of organic and mineral admixtures in the form of syrup, qualitatively not below 98%, and are forwarded for hydrogenation. Hydrogenation is carried out at a 120° temperature and at a pressure of 60 atmospheres in vertical reactors charged with skeletal nickel catalyzers. The xylite solution obtained is separated from the hydrogen and is allowed to proceed for ion-exchange purification, after which it is concentrated and can be released as a marketable product in the form of a syrup or a dsolid crystallized mass.

Fig. 1. Technological scheme of xylite production.

Xylite production by the described scheme makes it possible to obtain a product yielding up to 18% of the weight of the initial vegetable raw material and its net cost is below the existing price paid for glycerin and glycols. Nonetheless, as a result of the large quantities of steam required and the complicated cleaning, the specific capital investments per power unit remain relatively high and amount up to 12 thousand rubles per ton annually. In addition, the remainder after pentose hydrolysis - cellolignin - is used to obtain ethyl alcohol with indicators which are inferior to the production of this article at hydrolytic-alcohol factories processing the waste of wood.

For the further development of xylite production from pentosan containing raw material, it is necessary to improve the technology of its production by adapting the continuous counterflow in frefining the initial

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raw material, particularly, to apparatuses of the "VNITO" [All-Union Scientific Society of Engineers and Technicians] type, by finishing the method of continuous counterflow of pentose hydrolysis, simplifying the purification scheme for xylose solutions (continuous neuralization and vacuum-filtration), by the use of active carbon as adsorbents - Collactivite [kollaktivit] and new brands of ionites, [and] selection of catalizers for hydrogenation in an acid medium. Implementation of these measures will permit decreasing considerably the specific capital investments and to reduce the net cost of xylite.

The production of sorbite, similar to xylite, can be realized, but only by definitely using hydrolysis of cellulose containing materials concentrated by acids, since in hexose hydrolysis by diluted acids, hydrolysates, as a result of the unavoidable decomposition of monoses, are of low quality which makes it impossible to process them into sorbite.

In the production of sorbite, to begin with, cellolignin must be utilized after pentose hydrolysis of plant materials. This will permit not only e/more efficient processing of cellolignin in the production of xylite, but it will also increase 2--3 times the capacity of the hydrolytic factory manufacturing polyatomic alcohols, which will raise the effectiveness of an establishment of a similar type [profilia].

One of the trends in the radical improvement of the production of polyatomic alcohols from plant materials could be the production of pentites and hexites by direct hydrogenation of polysaccharides.

On the basis of the known established principle, that in hydrogenation of disaccharides and starch in a neutral and midly acid medium, there occurs a formation of corresponding hexites [12, 13], the authors in the Moscow Division of VNIIGS and at the Institute of Organic Chemistry,

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Academy of Sciences USSR, conducted investigations in hydrogenation under specific conditions of hemicelluloses and of cellulose. Experiments in hydrogenation of xylan hemicelluloses (isolated from centrifuged alkali of viscose production), marketable cellulose, pubescence [podpushok] of cotton seed, celloligain, and indirectly of the cotton boll [sheluzha] have confirmed [their] formation and the possibility of obtaining from them xylite and sorbite in practice. In so doing, the output of polyatomic alcohols reached 95% of the weight of the initial polysaccharides.

It has been established that conversion of polysaccharides during their hydrogenation in an acid medium and at a high temperature into polyatomic alcohols must be considered as a concurrence of two processes – hydrolysis and hydrogenation:

$$(C_5H_8O_4)n \xrightarrow{+n(H_2O+2H)} n(C_5H_{12}O_5)$$

$$(C_6H_{10}O_5)n \xrightarrow{+n(H_2O+2H)} (C_6H_{14}O_6)$$

Monoses obtained as a result of polysaccharide hydrolysis immediately add hydrogen to the aldehyde group forming polyatomic alcohol.

The latter principle is very important. It opens up wide possibilities for an almost quantitative transfer of polysaccharides such as cellulose into polyatomic alcohols, since conditions that decrease or exclude decomposition of monoses during their formation and isolation have been created. Transformation of polysaccharides into polyatomic alcohols can be arranged so that the rate of hydrogenation will be higher than the rate of hydrolysis and monoses will practically be absent from the process of hydrogenation. Under these conditions the real output of polyatomic alcohols will be determined solely by the rate of monose formation.

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This method of obtaining pentites and hexites makes it possible to simplify considerably their production and to increase sharply the output of finished articles. Direct hydrogenation of polysaccharides eliminates the process of formation and isolation of monosaccharides, and it presents the possibility of of utilising cellulose in the production of sorbite without its preliminary hydrolysis and the unavoidable losses connected with it.

The possibility of obtaining polyatomic alcohols is not excluded, neither in direct hydrogenation of plant material, or primarily cellolignin, but for this purpose it is necessary to find methods for the separation of catalisers from lignin and to solve other specific problems of conducting this process.

Pentites and hexites may turn out to be the most inexpensive polyatomic alcohols as regards the relative capital investment for their production as well as in their net cost compared even with synthetic glycols and glycerin. This is corroborated not only by data of research work and preliminary estimates, but also by indicators of industrial sorbite production in the USA [6].

GLYCERIN AND GLYCOL PRODUCTION

Glycerin and glycol can be obtained from polysaccharides of plant material by using chemical and biochemical processes. Literary data [5, 14] as well as investigations conducted by the authors of [this] article indicate that chemical production of glycerin and glycols is based on the capacity of pentites and hexites to split up [Begin p. 6] in the process of their hydrogenolysis* into a series of products of

* Hydrogenation with the simultaneous splitting of a molecule.

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less molecular weight down to monoatomic alcohols and hydrocarbons. Thus, for example, in hydrogenolysis of xylite and sorbite there form in part glycerin and glycols, and also erythrite and other alcohols:

$$C_5H_{12}O_5 \xrightarrow{+H_2} C_3H_8O_3 + C_2H_6O_2$$

$$C_5H_{12}O_5 \xrightarrow{+2H_2} C_3H_8O_3 + C_2H_5OH + H_2O$$

$$C_6H_{14}O_6 \xrightarrow{+H_2} C_4H_{10}O_4 + C_2H_6O_2$$

$$C_6H_{14}O_6 \xrightarrow{+2H_2} C_3H_8O_3 + C_3H_8O_2 + H_2O$$

Depending on the conditions under which pentite and hexite hydrogenolysis is carried out and on the catalyzer used, the corresponding products of their decomposition will also be obtained with varying quantitative results. Particularly, from sorbite, glycerin can be obtained up to 50%. Glycerin and glycols can be obtained also directly from polysaccharides by conducting hydrogenation in two stages - first at low temperature in an acid medium with the formation of pentites and hexites, and later at a higher temperature by adding alkali agents or by using another catalizer.

The individual components obtained as a result of hydrogenolysis of a mixture of polyatomic alcohols could be isolated by fractional distillation.

This means of obtaining glycerin has a number of positive aspects, but it requires further development of optimal conditions for the conduct of hydrogenolysis, as well as methods for isolating glycerin from a mixture of polyatomic alcohols. However, realizing in practice hydrogenolysis of pentites and hexites for the production of glycerin will become necessary only in exceptional cases, when glycerin cannot be replaced with penites and hexites.

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The biochemical method of obtaining glycerin and glycols from hydrolysates had not as yet been applied to practice anywhere, although many investigators have worked with it. The reason appears to be the relatively low output of glycerin (under laboratory conditions no more than 35% of the weight of the fermented sugar), large consumption of chemicals and difficultires in purifying and isolating marketable glycerin [3, 13].

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*

The production of polyatomic alcohols from plant waste is one way means of solving practically the problem of providing the national economy with glycerin and other equally valuable products obtained from inedible raw material. Speedy organization of the production of polyatomic alcohols will permit a saving of thousands of tons of scarse food products.

The technological scheme of producing plant materials must be realized on the principle of complex processing of raw material (fig. 2) and composed of hydrolysis of hemicellulose of the initial raw material, hydrolysis of cellolignin by concentrated acid, clarifying of blended monose solutions and hydrogenation, refining and isolating of polyatomic alcohols in the form of a pentite and hexite mixture or of their hydrogenolysis (in a case of necessity) with a subsequent fractional distillation of the developed glycols and glycerin. The scheme must also provide for the utilization of lignin and other production wastes.

Such scheme of obtaining polyatomic alcohols will permit not only the utilization of all polysaccharides by direct designation, but it will also increase several times the original concentration of sugars and hydrolysate, which will reduce drastically production's demand for steam.

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However, in obtaining polyatomic alcohols by direct hydrogenation of polysaccharides, the technological production scheme will look considerably more simple and will begin with the process of hydrogenation.

The release of a mixture of pentites and hexites in the form of marketable products will satisfy the demands of most consumers of polyatomic alcohols, particularly when used as plasticizers and stabilizers of moisture. However, in a case in which it is necessary to obtain individual varieties of polyatomic alcohols, production of sorbite must be based solely on the processing of cellolignin, pubescence of cotton seed or marketable cellulose, and xylite, on the use of xylan--containing raw material. Yet glycols and glycerin, as indicated above, can be obtained by hydrogenolysis of a pentite and hexite mixture.

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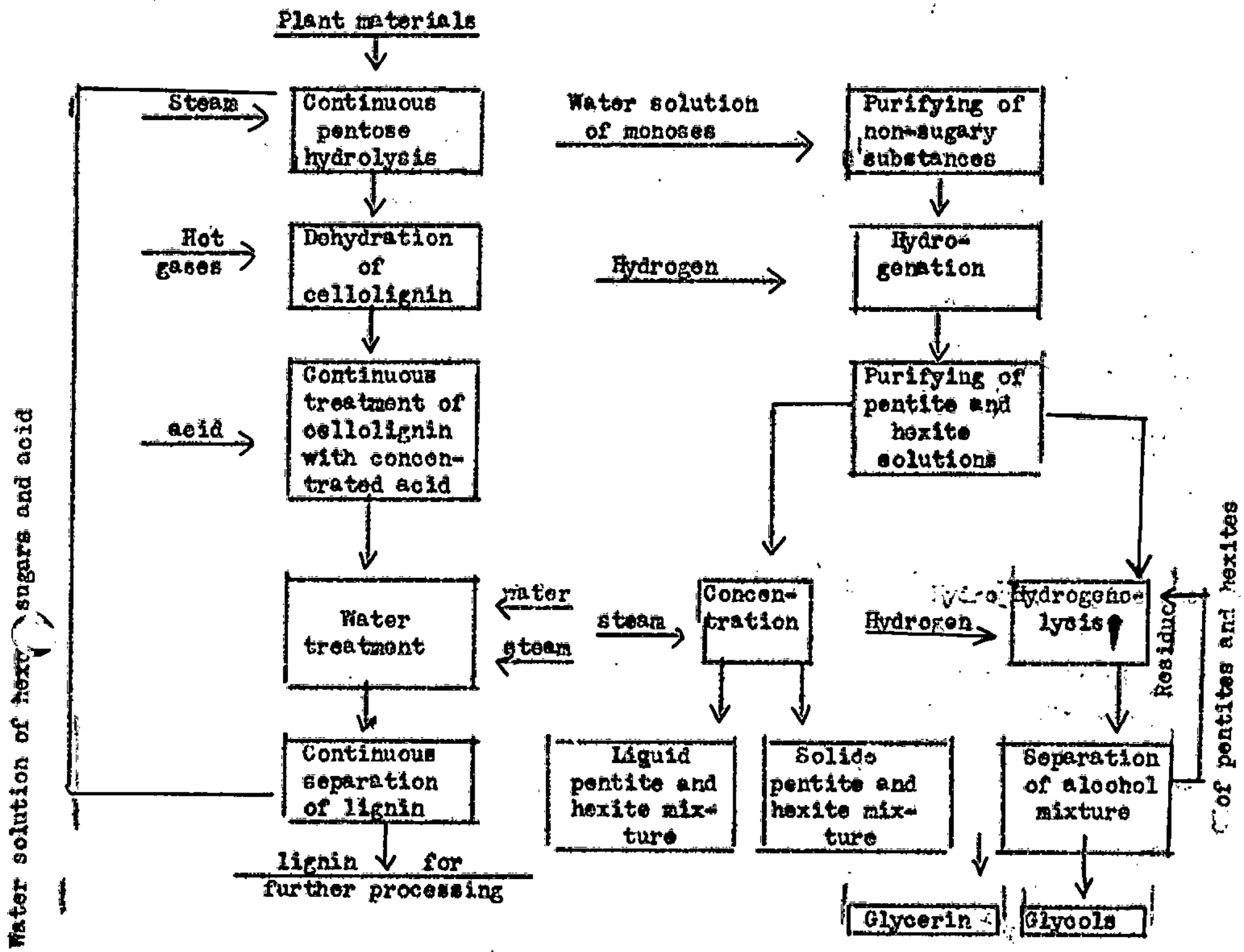

Fig. 2. Principal scheme for the production of polyatomic alcohols from plant material

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Industrial production of polyatomic alcohols from plant waste is a new aspect of hydrolytic production, no less effective than the existing aspects of hydrolytic alcohol, glucose, yeast and furfural production. If the output of the final manufacture of this production - ethyl alcohol, glucose, protein yeasts and furfural - amounts to a maximum of 40% of the quantity of polysaccharides in the initial raw material, then their output may reach 80% in the production of polyatomic alcohols. In other words, the raw material will yield twice as much valuable, fundamental marketable production.

For a practical organization and development of the production of polyatomic alcohols from plant waste, it is necessary to unfold widely scientific-research and experimental work in the following directions:

a) improving the existing technology of obtaining xylite from cotton bolls and sunflower husks, and also from maize stalks and wood from shade trees;

b) the quickest possible adoption of methods for the hydrolysis of cellolignin with concentrated acids;

c) development of technology for the production of pentites and hexites by direct hydrogenation of polysaccharides with the selection of the corresponding catalizers; [Begin p.6].

d) study of hydrogenolysis of pentites and hexites for the production of glycols and glycerin and their isolation from mixtures of polyatomic alcohols.

On the whole, however, the study of the chemical conversion of carbohydrates should be paid as much attention as is, in this regard, now apaid to hydrocarbons.

The potential possibilities of carbohydrate chemistry which are based on the intricacy of their molecules, on the ready decomposition of some of them,

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and on the great reactivity of the aldehyde and hydroxyl groups represent a new branch of the industry of organic chemistry. The importance of this problem is gaining general recognition and it receives increasing attention. Thus, for instance, in the USA a special fund has been set aside and in New York an institute has been organized for research in the sphere of chemical utilization of sugars [16]. In the near future polysaccharides of plant tissues will be an important variety of chemical raw material in the production of simple carbohydrates and their various derivatives.

CONCLUSIONS

1. Polyatomic alcohols and their derivatives are important products, necessary for a number modern preparations and for increasing the output of consumer commodities.

2. To increase further the production of polyatomic alcohols, it is necessary, concomitantly with obtaining glycols and glycerin from petroleum gases, to organize production of pentites and hexites as well as glycols and glycerin from inedible raw material of plants.

3. Chemical processing of the different plant wastes by the hydrolytic method permits organizing effective production of xylite and sorbite; specific capital investments per unit of power and the net cost of production could be reduced by using this method instead of obtaining polyatomic alcohols from petroleum gases. In a case of necessity, the production of glycols and glycerin could also be organized by means of pentite and hexite hydrogenolysis.

4. Production of polyatomic alcohols from plant material waste appears to be a new and progressive profile of hydrolytic production of great importance to the national economy.

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(Table of contents only)
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Gel'man, N. S. and Zenkevich, C. D., comps.

Biokhimiia rastenii; bibliogr. ukazatel' otechestv. lit., 1736-1952.

[Biochemistry of plants; bibliographical index of native literature, 1736-1952].

1956 241.75 G28

(In Russian)

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Arkhimovich, Aleksandr
(Archimowitsch, Alexander)

[Resul'taty kampanii po obespecheniiu skotovodstva v SSSR kormami pri pomoshchi rasshireniia posevov pod kukuruzoi.

[Results of campaign to provide feed for cattle in the USSR by expanding the cropping area under maize].

[Personal Communication to G. H. Coons, July 25, 1957, cf. attached correspondence].

(In Russian)

Status of the maize crop in the USSR prior to the campaign

Prior to World War II, maize in the USSR occupied the sixth place among other grain crops, following wheat, rye, oats, barley and millet. A noteworthy biological characteristic of this plant is its high heat reqirement. As a result, maize crops for grain were localized in the southern regions of the USSR.

The northern boundary of the maize crop planted for grain passed through Shepetovka, Zhitomir, Kiev, Nezhin, Lgov, Voronezh, Serdobsk, Syzran, Buguruslan [and] Orenburg (13). In the Asian part of the USSR, the northern boundary of the maize crop planted for grain passed through Orsk, Troitsk, Kustanai, the steppe section of the Minusinsk District and the southern section of the Vladovostok District (6).

Prior to the maize campaign initiated by Krushchev, the chief regions for maize crops grown for grain were the Ukraine, the Northern Caucasus and Transcaucasia. However, a considerable area was occupied by this crop also in the Central-Chernozem Oblast of the RSFSR and in the Volga

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area. As far as the area planted for grain is concerned, the movement to the north as a result of this campaign is not so considerable as the Soviet press usually represents it, but, rather, it has almost saturated those regions in which the feasibility of its culture had been demonstrated by earlier experiments.

To the north of the line indicated above, maize is grown with some success as a green forage for cattle. It must be noted that in the post-war years (after World War II) the maize crop grown as a green fodder and for silage has moved considerably to the north, but only to localities that had been prepared for such a movement by appropriate experiments conducted by experimental institutes.

Another biological characteristic of the maize plant is its drought resistance. It has, however, turned out that this quality had, to a considerable degree, been exaggerated. Maize gets along with insufficient moisture only during the first half of the vegetative period. The critical period is the time from mid-July until mid-August when flowering and the initial ripening of the grain occur. Drought, low relative air humidity and great heat entail at this time a sharp decrease in and, sometimes, complete destruction of the yield. In contrast, a sufficient amount of atmospheric precipitation during the second half of the summer (July-August) is always accompanied by a good maize yield. As a result of its sensitivity to moisture deficiency during the second half of summer, maize has not advanced far into the South-East of the RSFSR. In these regions millet is grown instead of maize. The relative density of maize acreages in Russia in the prerevolutionary period is shown in the publication titled "Agricultural Trade in Russia

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[Sel'skokhoziaistvennyi Promysel v Rossii]" (10). The distribution of maize crops grown for grain in the USSR also is shown on maps in Kuleshov's monograph (6). The geographical distribution of maize varieties is given in the monograph by V. Talanov and M. Kalinin (13). For monographic descriptions of the crop in [pre-Soviet] Russia, the work of V. V. Talanov (12) published in the Yearbook of the Department of Agriculture is cited; for the Soviet period, the work of N. Kuleshov (6) as well as the joint work by V. V. Talanov and M. Kalinin (13) may be consulted.

The cropping areas under maize, the average yields and the total yields as grain, for Russia and for the Ukraine before the revolution and in the USSR after the revolution are given in publications by the author of the present article (1, 2, 3).

Expansion of cropping areas under maize aimed toward organizing a supplementary forage base for livestock

The matter of expanding cropping areas under maize was raised by Khrushchev (14) in the report submitted to the Plenum of the TsK KPSS [Central Committee, Communist Party of the Soviet Union], on January 25, 1955.

In his report devoted to the problem of increasing the production of livestock products, Khrushchev dwelt chiefly on two questions:

1) On the further adaptation of virgin soils and waste lands.

2) On the matter of expanding plantings of maize not only as a grain crop, but also as a silage crop.

Within the very short period of 5 years, Khrushchev proposed to bring about an expansion of the cropping area for maize by six and a

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half times the 1954 area and to bring the maize area up to 28 million hectares by 1960. In addition, the proposal was made that the objective of this crop be radically changed. Prior to Khrushchev's address it was basically a grain crop and was harvested in a state of full grain ripeness. A considerably smaller portion of maize was seeded as a silage crop and was harvested before ripening not for the sake of grain, but for its green mass. Khrushchev proposed thatthe main quantity of maize be seeded for silage, that it be harvested in a state of milk-waxy ripeness, and that the ears by silaged separately from the stems.

In addition, he declared authoritatively: "Can a grain in milk-waxy ripeness be compared to a ripe grain? Yes, it can. An unripe grain is just as nourishing as a ripe grain. No one disputes this fact." Khrushchev neglected to add that in the Soviet Union, naturally, no one would dare to dispute an assertion made by the First Secretary of the KPSS, yet in the free world any school boy could prove readily the absurdity of this assertion. In any case, the proposition was set forth and a new program for the expansion of the area under maize was accepted. The undertaking was confirmed in the Directives of the 20th Congress of the KPSS dealing with the sixth five-year plan of development of the national economy in the USSR for the years 1956-1960.(4).

Once the task was set, the management of kolkhozes and sovkhozes could do nothing else but proceed with the greatest of zeal to implement it. And since in the USSR fulfilment denotes primarily the quantitative aspect, the area under maize began to grow beyong control.

As early as in 1955 the area under maize comprised 17.9 million hectares (Pravda 23 July 1955). A colossal jump, if one considers the fact that in preceding years the area under maize planted for grain ranged as follows: in 1940, 3.6 million hectares; in 1950, 4.8 and in

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1954, 4.5 million hectares (7).

The reference work "National Economy of the USSR [Narodnoe Khozia-stvo SSSR]" does not indicate the figure for 1953, a year of failure, but Khrushchev in his report of January 25, 1955, let it slip that it equalled 3.5 million hectares. In 1955, of the total area of 17.9 million hectares under maize, 9.1 million hectares were allocated for grain and 8.8 for silage.

In the individual Republics the area under maize in 1955 was distributed (in thousand hectares) as follows (7):

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Table 1.

Area under Maize in 1955:

From National Economy in the USSR, 1956.

[Estimates given in thousand hectares]

	For Grain	For Silage and Green Fodder
USSR	9111	8806
RSFSR	2966	6093
Ukrainian SSR	4773	1266
White Russian SSR	70	248
Uzbek SSR	69	49
Kazakh SSR	100	665
Georgian SSR	322	41
Azerbaidzhan SSR	41	37
Lithuanian SSR	17	136
Moldavian SSR	556	58
Latvian SSR	6	110
Kirgiz SSR	93	57
Tadzhik SSR	12	20
Armenian SSR	5	9
Turkmen SSR	12	10
Estonian SSR	0.2	39
Karelo-Finnish SSR	-	4

An analysis of Table 1. indicates that in 1955 the bulk of the maize crop was distributed in the Ukraine and in the RSFSR, and while the culture in the Ukraine was for grain, the culture in the RSFSR was for silage. Besides the Ukraine, culture of grain predominated in Georgia and in

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the Moldavian SSR; the growing of the crop for silage was the chief objective in the RSFSR, as well as in White Russia, Kazakhstan, Lithuania, Latvia and Estonia, and even in the Karelo-Finnish SSR.

In 1956, 23.9 million hectares in the USSR were cropped to maize (11).

The increase in the area devoted to maize involved expansion into oblasts and republics in which the crop had very small distribution or had not been grown previously as well as the expansion of acreage in regions where maize had long been grown. Substitution of maize for grasses or for grain and for forage crops was necessary. In some cases meadows and pastures were plowed for the maize crop.

The Republics in which the maize crop appeared to be entirely new were White Russia, Lithuania, Latvia, Estonia and the Karelo-Finnish SSR. Inexperience explains their failures in consummation of the plan. Kazakhstan, too, proved unequal to the sudden expansion of the plan in the year 1955.

The size of the area under maize planted for grain varied in Kazakhstan in different years as follows (7).

Table 2.

Area planted to maize in Kazakhstan

[Estimates given in thousand hectares]

1940	1950	1954	1955
10	51	49	160

Thus, the area in maize intended for grain increased in 1955 three times as compared with 1954 and thirteen times as much area in maize intended for silage was added. How far north the expansion of this crop advanced is indicated in a report that appeared in "Pravda" of May 31,

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1955 concerning maize crops in Sakhalin.

Hence, it is not surprising that the maize campaign of 1955 was a failure in the new regions, as evidenced by numerous reports in the Soviet press. In his report to the 20th Party Congress Khrushchev announced (15) that in some of the regions of White Russia, Latvia, Lithuania, and Estonia, the Kostroma, Yaroslav, Tula and certain other oblasts "maize had produced no results." Khrushchev attributed the failure not to the fact that maize was new in these regions, but to "the careless attitude" toward it, as if the agronomists and local agrarian workers would have dared to maintain a careless attitude toward a governmental campaign of primary importance.

The explanation is simple. The plan for cropping large areas to maize in new regions was ordered and results were compiled. Owing to inexperience these results were deplorable. These occured so often that in the appeal of the TsK KPSS, dated March 27, 1957, addressed to sovkhoz workmen and employees, it says literally as follows (9):

"Until now, however, we have many cases in which maize seeded on sovkhozes perishes or produces a very low yield." As to how farmers get out of a difficult situation is mentioned in the appeal of the TsK KPSS, dated January 17, 1957, addressed to kolkhozniks (8). "Lately, an improper practice has been spreading in our country, in a number of kolkhozes and sovkhozes negligent farmers have been responsible for the destruction of maize crops and, trying to evade the responsibility, they camouflage the ruined crops as having been fed to cattle as standing maize 'from under the hoof'".

"An end must be put to this in 1957" it says in the appeal of March 27, 1957, and further there is the threat that: "in the current year not a single case of maize loss or low yield is to remain without an appro-

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priate explanation or without taking the required measures."

Thus, in regions new to it, the maize crop has failed. Perhaps with the aid of draconic measures which, apparently, are indicated in the appeal of March, 27, 1957, adaptation of this crop may gradually be accomplished in those new regions in which conditions are conducive to it.

The situation is no better in old regions of maize culture. Here the expansion of maize crops was made possible either by means of replacing other crops, such as grain, forage, and grasses, or by plowing and utilizing meadows, pastures or other resources. Precisely both of these methods are recommended in the decrees of the TsK KPSS of January 31, 1955.

Ivantsov points out in his work (5) that with this decree the TsK KPSS forces farmers to use predatory means since it leads to increased exhaustion of soil fertility.

The agrotechnics for maize crops proved most inadequate not only in the regions new to this crop, but even in the old ones. Issues of the newspaper "Pravda" abound in reports on deficiencies. We shall cite only a few of them.

In the issue of March 3, 1955 - disturbing news from the Crimea concerning the situation of the planting campaign.

In the issue of May 29, 1955 - reports on sparse maize sprouts and on failure to carry out necessary replanting.

In the issue of May 31, 1955 - it is reported that maize crops are not being tended properly.

In a leading article of July 23, 1955 - important shortcomings in the care of maize crops are again reported.

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Important agrotechnical defects were due to the fact that agronomists were using methods in the new regions that had been developed for old regions. An example of this sort is cited in the appeal of the TsK KPSS of January 17, 1957 (6) which indicates as follows: "...in the non-chernozem zone seed are buried in heavy, moist soil just as deep as in the south where the soil is lighter and where there is moisture deficiency". However, even in the regions in which a crop was produced, it is not always harvested on time.

The newspaper "Izvestiia" of September 16, 1956 reports that in the year 1955, in the Plastun Raion, hundreds of tons of maize have decayed in the field. Such was the agrotechnical situation with maize in 1956.

Hence, it is not surprising the Soviet statistical publications fail to cite data that would enable one to estimate the yield per hectare, or the absolute instead of the relative size of the total yield. Instead, in propaganda separate, high examples are cited as incentives. Thus, for example, in the appeal of the TsK KPSS of January 17, 1957, to which we referred, it is indicated as follows: "A fairly good yield - up to 200 centners per hectare has been obtained everywhere, in all regions of the Soviet Union in which agricultural crops are grown, even in the North, and in the central belt 500, 600 and even 700 centners per hectare of green mass".

That this is no more than a propaganda assertion is evidenced by the fact that a few lines lower it reads as follows: "In many regions of our country we still produce a low yield, considerably lower than the possible average yield for this crop".

This fact has been confirmed by the following lines in the leading article in "Pravda" of March 24, 1957: "In the current year special

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attention must be paid to the growing of a high yield of maize. It must be taken into account that last year the yield of this most valuable crop was so low in a number of regions".

The situation in silaging the green mass of maize is no better. For the quantity of silage put up there are available only comparative figures in relation to an unknown but low index adopted by Soviet statisticians. Data for the year 1954 which have never been published in absolute quantities were selected as indexes for maize. Data for 1955 are given in Khrushchev's report read to the 20th Party Congress and in the leading article in "Pravda" of March 31, 1956. If the article can be trusted, then the amount of silage put up in 1955 exceeded that of the previous year by 17 million tons, including more than 6 million tons of ears.

In the leading article of August 22, 1956 it says that "this year" there will be put up about 177 million tons of silage - three times as much as in the past year. Proceeding from these figures, we estimate that the amount of silage in 1955 was 59 million tons and in 1954 - 42 million tons. This amount is entirely inadequate to provide cattle with silage.

According to Soviet statistics (7) the number of cattle in the USSR has been estimated by year as follows: for 1954, 64.9 million head; for 1955 67.1 million head. Consequently, the amount of silage per head would have been: in 1954, 0.6 tons and in 1955, almost 0.9 tons, that maize silage was fed only to cattle, to the disadvantage of other types of livestock. This quantity is very far from the undertaking stipulated in the appeal of the TsK of January 17, 1955, "to have everywhere no less than 10 tons of silage per cow". Thus, the cows in the Soviet Union get only 1/10 of the silage ration which the agricultural leaders of the USSR themselves considered as the minimum.

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The situation with respect to building new siloe and repairing old structures, which in the USSR have been built primitively, is in a sad state. A leading article in "Pravda" of July 23, 1956 reports as follows - "a serious retardation has been permitted to occur in the building of lined silos". The leading article in "Pravda" of July 22, 1956 states that at the beginning of August only 1/3 of the silos had been finished, yet the harvest was already on and by the 15th of July 19.4% of the cropping area under maize had been harvested.

Maize failures in the USSR reached such dimensions that Khrushchev in addressing the Conference of the Agricultural Workers of the Non-chernozem Zone, USSR, March 30, 1957, had to authorize them not to plant maize in areas in which it is not economical and produces low yields. After many years of unsuccessful attempts to adapt maize to regions that are not conducive to it, he became convinced of the elementary truth that: "If the yield of one crop is to be compared with the yield of another, then one should choose the crop which is more profitable under the concrete conditions of any one region (16).

Apart from a long line of other fundamental causes, failures with maize in the USSR were explained by the absence of local maize varieties. The agricultural leaders in the USSR knew very well that the success with maize in the United States of America was due to the great successes in genetics and in practical selection in this country.

In America, as in a number of European countries, wide utilization is made of hybrid seed, that is obtained as successful, thoroughly tested combinations of maize inbreds.

In the late thirties and in the early forties similar experiments were conducted by N. P. Sokolov the plant breeder, at the Dnepropetrovsk

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Selection Station. However, since in the initial stage of the work it became necessary to use closely-related intra-varietal breeding and inbreeding and since T. Lysenko showed a hostile attitude toward the use of this method, work of this type was discontinued.

Approximately 20 years later official permission to reestablish the work in this direction was finally given and, besides, a directive issued during the January 1956 Plenum of the Central Committee provided for switching all maize plantings to hybrid seed within the next three years.

In the year 1955 a "delegation of kolkhozniks" paid a visit to the maize-growing states of USA and they convinced themselves of the superiority of the American method. The delegation included the important scientist and plant breeder, B. P. Sokolov, who 20 years before had to discontinue work done by the method that had produced such brilliant results in America. At present, there are great expectations from the hybrid maize in the USSR.

At the 20th Party Congress a directive was adopted for the "organizing of large-scale growing of hybrid maize seed". (Pravda, February 26, 1956).

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July 26, 1957

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Shumilenko, E. P.

Perezimovka steblevoi rzhavchiny
(Puccinia graminis Pers.) v usloviiakh
sverdlovskoi oblasti.

[Overwintering of stem rust (Puccinia
graminis Pers.) under conditions of the Sverdlovsk Oblast].

Botanicheskii Zhurnal, vol. 42, no. 1.
pp.95-97. Jan. 1957. 451 R923

(In Russian)

It is known that the uredospores of leaf rust of wheat (Puccinia triticina Ev. et Henn.) possess high cold resistance and, hence, are able to overwinter at low temperatures without losing their viability.
[Begin p.96].

As far as stem rust is concerned, lately until it has been held that this fungus species fails to overwinter in uredo-stage. The possibility of its overwintering in uredo-stage has been denied by such important investigators as A. A. Iachevskii (1909), L. F. Rusakov (1926, 1927), M. V. Gorlenko (1948) and others. All of them considered that the fungus passes the winter in the telio stage. Recently, however, publications of individual workers have appeared which show that in some regions, under certain conditions, the overwintering of this rust in the uredospore stage is possible.

Thus, according to the observations of V. A. Bryzgalova (1935) teliospores of Puccinia graminis scarcely ever occur under East Siberian conditions and the rust hibernates under the snow in the uredo-stage on winter crops. On the basis of this, the author assumes that the fungus overwinters in the uredo-stage on quack grass (Agropyrum repens) and winter rye.

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G. F. Maklakova expresses the hypothesis that the overwintering of this type of rust in the uredospore stage is possible in districts of the Leningrad Oblast.

N. A. Naumov, in the monograph "Rust of Cereals in the USSR" (1939), cites data mostly of foreign authors who also consider that the overwintering of uredospores of this rust is possible in countries with a milder climate. All of these indications have not, however, been confirmed by appropriate experiments. Only in recent times has it been proved experimentally that preservation of uredospores during the winter is possible without loss of their germination capacity.

It was learned from the work of L. F. Pivkina (1951), which she accomplished at the Far-Eastern Branch of the Academy of Sciences USSR, that uredospores of stem rust (Puccinia graminis f. tritici) overwinter well on the straw of wheat and preserve the ability to infect wheat sprouts and mature plants in the following spring; it has been established that plant refuse can be a source of uredospore infection.

Johnson and Green (1952) have also demonstrated the possibility of uredospore preservation on plantings of winter crops under conditions of Canada and the Northern States of the USA. These authors, however, consider that overwintering in the uredospore stage is possible only in certain years.

Works devoted to the study of stem rust in the Central Urals are almost non-existent, if we disregard an article by Z. A. Demidova (1927) who found no barberry in the Sverdlovsk Oblast and attributes the appearance of stem rust to rust spores brought in by winds from southern regions in which barberry is prevalent. Hence, in conducting a study of the microflora of the Sverdlovsk Oblast, we carried out observations on the overwinter-

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ing of stem rust of cereals.

The material used in the present article came from observations of rust development conducted in 1951-1952 and in 1954-1955. During an inspection of winter rye crops on an experimental plot of the Institute of Biology UFAN [Ural Branch of the Academy of Sciences] and on test plots in the Sverdlovsk Oblast (in 1951), it was established that rye sprouts had a severe, 100% infection by uredospores of stem rust. Further observations showed that the uredospores had gone into hibernation without being replaced by telio pustules. We are inclined to explain the occurrence of stem rust on winter crop plantings by weather conditions favorable to the development of this type of rust. It is well known from literature that Puccinia graminis belongs to the more thermophilic rust species. The warm autumn of 1951 favored the development of the disease.

In 1952, we did not succeed in ascertaining the viability of the overwintered uredospores. Nonetheless, there were indirect observations that confirmed their capacity to live. Thus, in the spring of 1952 we observed individual pustules of stem rust uredospores immediately upon the melting of snow. Besides this, the first infrequent pustules of this stage of the fungus were discovered on winter rye and wheat at the end of June. Such an early attack occurred without the participation of barberry. Intensive development of this type of rust was noted in individual districts of the oblast during the summer.

These observations demonstrated the possibility of preserving the viability of stem rust uredospores during the winter period on winter crop plantings under conditions of the Sverdlovsk Oblast.

To establish this fact, we tested spores for their capacity to germinate in the fall and winter of 1954 and in the spring of 1955. The

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uredospores were collected from winter wheat crops on an experimental plot of the Sverdlovsk Branch of the All Union Institute of Plant Industry (VIR). In October, some plants together with the uredopustules were placed in test tubes and left for the winter outside the window. Germination tests of the uredospores collected from crops and stored in test tubes were conducted.

Viability of hibernating and overwintered uredospores was tested by the germination method.

An aquaous suspension was prepared with distilled or boiled water. Drops of water with spores were placed on microscope slides which were put in a moist chamber set up in Petri dishes. In the course of ten days the spores were examined under the microscope. Spores with the capacity to survive germinated, as a rule, on the second day [more than 24 hrs later].

As a result of the work done it was established that uredospores overwintering on plants under natural field conditions retained viability up to the middle of December. The uredospores that had been kept in test tubes also lost viability by that time. [Begin p.97]. In further analysis the number of uredopustules was negligible and uredospores failed to germinate; they were, as a rule, colorless.

Despite the loss of uredospore viability in winter time, we continued to germinate them until warm weather set in. The last viability test was conducted in April after the melting of snow. In this instance, the overwintered spores taken from the field germinated in considerable numbers, the sprouts were 6--22 mu long.

Even though the spores tested during the winter failed to germinate, we, nonetheless, feel that the last analysis has demonstrated that

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uredospores can spend the winter on winter crop plantings. Failures during in germinating the spores during the winter are explained by an error in methodology. It was due to the fact that the uredospores were transferred directly from the field to the laboratory. Such a sharp change in temperature could exert a negative influence on their germination and, therefore, the spores, in all probability, perished in the laboratory. We believe that uredospores of stem rust can overwinter only in certain years and that it depends primarily on weather conditions.

The fall and winter of 1954/55 were favorable to overwintering in the uredo-stage. In September the weather was warm, the average monthly air temperature was 2° higher than the average for many years. Precipitation was also heavier than the average amount for many years. Temperatures below +5° set in about the middle of October, during the rainy season with precipitation occurring in the form of rain and snow. There formed a temporary snow cover up to 10 cm thick which disappeared on the 24th of October as a result of a short spell of warm weather. Temperatures below zero set in only by the 10th of November. Consequently, there was a warm fall, distinct from preceding years, and a longer one due to the protracted instability of the weather before winter set in. Such weather conditions in the fall favored the development of stem rust and the preservation of the vitality of spores which acquired a natural hardening. It is known from literature that exposure to hardening increases considerably the frost resistance of uredospores, and *Puccinia graminis* can survive without injury a period of 45 days at a 40° [C] temperature (Naumov, 1939).

Furthermore, during that winter [1954-55] a lack of snow was observed. The prevalence of low temperatures and an inadequate snow cover subjected the upper soil layers to severe chilling, but in January and

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February the weather was usually [sic] warm with an insufficient amount of precipitation. The average temperature for January exceeded the average for many years by 4.5--7.5°. The average monthly temperature was: in September 6/11.7°, October /4.1°, November -5.0°, December -8.2°, January -9.4°, February -13.6°, March -9.0° and April /3.3°.

The data cited indicate that the existing conditions favored the development of uredospores and inhibited the formation of teliospores, and were conducive to overwintering in the uredo-stage.

The observations cited in our work and data examined from the literature prompt the conclusion that stem rust of cereals attacks the sprouts of winter crops under conditions of the Sverdlovsk Oblast (Central Urals). As a rule, teliospores do not form in the fall and the rust overwinters in the uredo-stage. Uredospore overwintering is observed only in individual years that favor the development of this type of rust. Hence, in the control of the infection source indicated, agrotechnical measures designed to increase stem rust resistance in winter crop sprouts acquire importance.

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Basin, D. M., and Barkan, N. V.

Resursy pentozansoderzhashchego syr'ia i vozmozhnosti ikh ispol'zovaniia*.

[Resources of pentosan-containing raw material and the possibilities of their utilization*]

Gidrolisnaia i Lesokhimicheskaia Promyshlennost', vol. 9, no. 1. pp.26-27. 1956.
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(In Russian)

The Soviet Union has at its disposal vast and varied resources of raw material containing pentosan; the basic types of it include the wood of foliate trees, lumbering waste, cotton[seed] husks, sunflower husks, straw, maize stalks, reed (cane), hulls from groat factories and mills, brome grass, pentosan-containing production waste of sulfite and sulfate cellulose and of the hydrolytic industry, and the squeezings obtained in mechanical dehydration of peat etc.

The profits obtained from industrial processing of various types of pentosan-containing raw material depend on the following factors:

1) the availability in the individual regions of sufficient reserves and large concentrations of raw material that make it possible to organize establishments of optimal magnitude with the least explöitation cost;

2) favorable conditions of procurement of raw material at a minimum cost of its delivery;

*Material was selected with the assistance of Engineer P. I. Shirokova, fellow worker of Giprogidrolis [State Institute for the Planning of Hydrolytic Plants].

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3) the absence of other consumers of raw material and the expedience of its utilization for the given purpose.

The factors cited must be taken into account when each type of pentason-containing raw material is examined.

Wood of shade trees and waste from timber cutting. The total reserves of mature and overmature timber in the Soviet Union comprise up to 440 billion m^3, including over 3.5 billion m^3 of shade trees. In the accepted quantity of timber procurement, the annual yield of shade trees amounts to more than 30 mln m^3.

The districts of the greatest concentration of shade trees and, consequently, the possible centers for the construction of hydrolytic factories are Petrozavodsk, Zheshart, Kozhva, Syktyvkar, Molotov, Tavda, Salekhard, Asino, Yeniseisk, Chuna, Bratsk, Ilim, Ust'-Kut, Kirensk, Obor, Komsomol'sk [and] Svobodnyi. At each of these points, the quantity of shade tree wood exceeds 150 thousand pl. [planned ?] m^3 annually, which makes construction of hydrolytic factories of great capacity possible.

Waste of up to 60 million m^3 of cutting area (including 10 mln m^3 of shade tree waste) is left annually in the upper and lower warehouses of lespromkhozes [forest industry establishments]. A preponderant portion of it is burned for the purpose of sanitation on the cutting area, which consumes up to 20 mln man-days annually, i.e. an average of 70 thousand men perform annually unproductive work.

In solving the problem of utilizing forest clearing waste one should not take an organization of small production for orientation, because it will unavoidably prove uneconomical. Hydrolytic production should be organized in

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the lower warehouses of lespromkhozes which have a volume of procurement no less than 250-300 thousand m^3 with sufficient liquid reserves (for 35-40 years) and under the condition of industrial processing of all waste obtained (lumbering waste, waste from woodworking, timber sawing and unprofitable kindling wood etc.). The total amount of hydrolytic raw material found in this type of lower warehouse will comprise 100-150 thousand m^3, which is entirely sufficient for the organization of hydrolytic production of average capacity with complex processing of wood for furfural and yeast. According to preliminary estimates in the different forest regions of the country such lower warehouses number up to 80. Having organized within them hydrolytic production, it will be possible to utilise up to 6 mln. m^3, i.e. up to 12% of the total amount of waste left annually in cutting areas in the forest.

Cotton[seed] husks [shelukha]. The basic quantity of husks accumulates at oil factories of the Turkmen, Uzbek, Tadzhik, Kirgiz, Kazakh, Armenian and Azerbaidzhan Republics. The total yield of husks which are a waste of oil production amounts to many hundreds of thousands of tons annually. At some large oil factories hydrolytic plants that process cotton[seed] husks have already been built or are being build.

As a result of the intensive development of animal husbandry, cotton[seed] husks acquire great importance as a valuable feed product. Therefore, the further organization of hydrolytic establishments for the processing of cotton[seed] husks will depend on the status of a livestock forage base in cotton growing regions.

Sunflower husks. Sunflower husks also accumulate at oil factories in quantities that are adequate for organizing commercial processing at the required rate. Construction of hydrolytic plants that will process the waste of the Krasnodar and the Kropotkin oil factories is now in progress.

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According to preliminary data, the total amount of husks that could be used as raw material at hydrolytic factories comprised up to 140 thousand tons annually.

The amount of husks received at one oil factory fluctuates between 0.6 and 35 thousand tons per year.

As a result of decreasing the glumaceousness of seed, the yield of husks has at present decreased from 35 to 28% of the seed weight. Hence, the annual yield of husks does not surpass 21--22 thousand tons even at the larger factories, yet the requirement for a hydrolytic factory of optimal capacity is 30--35 thousand tons. Therefore, the further construction of hydrolytic plants that process sunflower husks depends on the feasibility of briquetting husks for economical transportation and on the use of other types of raw material available in the district in which the establishment is to be constructed.

Straw. The possible total yield of straw from grain crops in the country will reach by 1960 - 150 million tons, including up to 115 million tons on kolkhozes. The largest portion of the straw - up to 95% - will be obtained in four Republics: in the RSFSR - 64%, in the Ukrainian SSR - 17, in the Kazakh SSR - 11 and in the White Russian SSR - 3%.

In all of the Union Republics, with the exception of some Territories and Oblasts of the Russian Federation, the entire yield of straw is to be used as rough feed and litter for cattle. It is presumed that, after satisfying local demands, free resources of straw from grain crops will be left only in some regions of the Urals, Siberia, the Far East and the Northern Caucasus. Available left-overs of straw ranging from 1--2 million tons are expected in the Altai and Krasnoiarsk Territories, in the Cheliabinsk and Amur Oblasts, and from 0.2--0.5 million tons in the Novosi-

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birsk and Omsk Oblasts, and also in the Krasnodar and Khabarovsk Territories. Considering that these resources have been distributed in small amounts on individual kolkhozes and sovkhozes which impedes transportation and increases the cost of their commercial processing, we assume that at the present time straw [Begin p.27] should be excluded from the resources of pentosan containing raw material on the base of which large-scale commercial production could be organized.

On large sovkhozes and kolkhozes straw could be converted to yeast by installations of small capacity.

Maize cobs. In accordance with the planned distribution of maize crops to be grown for grain and silage and with the anticipated grain yield, the total yield of maize cobs on kolkhozes and sovkhozes will in 1960 amount up to 3.5 mln tons.

Maize cobs appear to be a most valuable raw material containing up to 40% of pentosans. Hence, commercial processing of maize cobs, which can be stored and transported at the same cost, present greater interest.

The principal maize regions in which it is planted for grain, and, consequently, the regions of a possible concentration of maize cobs, are the Northern Caucasus, the Ukrainian SSR, the Moldavian SSR and in part the Kazakh SSR in which up to 80% of maize planted for grain are concentrated.

Quantities of maize cobs that are sufficient to provide a hydrolytic enterprise of optimal capacity with raw material are available solely on large kolkhozes and sovkhozes and at elevators with a considerable capacity for the shelling of maize ears. According to preliminary data, up to 40-50% of the total harvest of maize planted for grain is received at these centers.

Thus, maize cobs which can be considered as pentosan containing raw material for chemical processing will by 1960 comprise 1200-1500

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thousand tons per year.

Reed (cane). According to approximate data, in the USSR reed overgrowth containing up to 27% of pentosans occupies an area of 3-4 million ha with an annual yield of 24 million tons; the heavier overgrowth is concentrated in the Volga Delta and in the Kazakh, Uzbek, Ukrainian, Moldavian and Azerbaidzhan Republics.

The more interesting reed overgrowth is found in Kazakhstan, Uzbekistan and the Volga Delta.

The total area of the reed overgrowth accounted for in the Kazakh SSR comprises about 1.1 million ha with an annual reserve of 15 million tons; in the Uzbek SSR - 225 thousand ha with an annual reserve of 1350 thousand tons. An area covered by reed inspected in the Volga Delta comprised 170 thousand ha with an annual reserve of 1260 thousand tons, including 420 thousand tons in the coastal zone. In other regions the commercial reserves of reed are approximately similar: in the RSFSR (Astrakhan, Groznensk and Novosibirsk Oblasts, and Krasnodar and Altai Territories) - 2 million tons, in the Ukrainian SSR (Kherson and Odessa Oblasts) - 0.5 million tons.

The general level of reed consumption (chiefly for local needs) amounts to no more than 10% of its annual yield.

Hulls at groat factories and mills. The amount of hulls obtained in processing oats, buckwheat, rice and barley as groats comprises from 10 to 26% of the weight of the processed grain. It can be anticipated that in 1960 the total amount of this waste will be about 600 thousand tons. The larger procurement establishments of the Ministry, for instance, in Chkalov, Shcherbakov and Abudino may serve as direct raw material bases for hydrolytic plants of optimal capacity. Other centers, however, may

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serve as raw material bases for hydrolytic plants only on the condition that the lacking raw material will be supplied by other establishments.

Waste of flax and hemp fiber. This waste is obtained in the first commercial processing of flax and hemp. It is expected that in 1960 this waste will amount to about 1.3 million tons, including 1 million tons of flax fiber and 0.3 million tons of hemp. At individual factories the yield of this waste fluctuates from 1 to 3 thousand tons per year. This amount is inadequate for chemical processing by the hydrolytic method, yet its transportation from a number of factories to points of possible processing is undesirable because of its insignificant volume.

Pentosan containing production waste of sulfate and sulfite cellulose. Sulfite alkali that contain hemicellulose are used in the production of ethyl alcohol and feed yeasts. In sulfate digestion of cellulose the sugar is not being utilized. It not only is lost irrevocably, but the quality of cellulose often deteriorates.

Up to 20 thousand tons of pentose sugar can be obtained at a sulfate cellulose factory, with an annual average capacity of 100 thousand tons of cellulose, by the prehydrolytic method, which makes it possible to organize large-scale production of feed yeasts or other products.

In producing sulfate cellulose at the planned rate, the organization of prehydrolysis of the processing wood will supply the country with hundreds of thousands of tons of pentose sugar. As a result of this, the problem of utilizing pentose sugar at sulfate cellulose factories is a very realistic one.

Pentosan containing waste of hydrolytic production. In complex processing of wood by the hydrolytic method, pentose sugar is used in the manufacture of furfural and protein yeasts.

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Up to 0.35 kg of furfural per decaliter of ethyl alcohol is formed during the production process, which, on the average, will comprise approximately 700 tons per year at one factory.

At present, furfural is manufactured only by the Kansk and Krasnoiarsk factories. Furfural installations in other factories have been planned, but have not yet been constructed.

The realization of contemplated future plans for the development of the hydrolytic industry within the next five-year plan will permit obtaining an added thousand tons of furfural and tens of thousands of tons of yeast per year.

It should be noted that, even with the contemplated volume of hydrolytic production, only about 2 million m^3 of tree sawing and wood-working waste (not counting wood) will be processed, i.e., a mere 5% of such waste.

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In the USSR resources of various types of pentosan containing raw material are enormous. Since at present it is impossible to organize complete commercial processing of all types of waste, it must be decided which of them are to be used first and to what extent. Besides, provisions must be made for a correct geographical distribution of the industry and expedient utilization of the waste.

On the basis of collected data it can be concluded that pentosan containing products of hydrolytic, sulfate and sulfite cellulose production should be utilized first; then, wood clearing waste and uneconomical fuel wood, reeds and maize cobs.

In resolving the practical problem of industrial utilization of pentosan containing raw material it is necessary:

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1. To establish a balance between consumption and production of various types of pentosan containing raw material and the products obtained from its processing all over the country, so as to distribute industrial establishments more correctly.

2. To develop production technology and draft documentation for establishments using several types of pentosan containing raw material, and also the technology of complex utilization of the wood of shade trees.

3. To find methods for packaging and briquetting forest clearing waste as well as sunflower husks and groat hulls for the purpose of improving their transportability.

4. To prohibit the use of pentosan containing raw material as fuel and to order oil and fat trusts to switch to other types of fuel.

5. To inspect individual centers with the greatest concentration of maize cobs and to develop better facilities for the delivery of the raw material to the processing place.

6. Mechanizing the storing and gathering of reeds and creating eco-nomically expedient conditions for their delivery to the processing place.

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Meisel', M. N.; Gal'tsova, R. D.,
El'piner, I. E., and Vakina, I. P.

Vliianie ul'trazvukovykh voln na soderzhanie sterinov v drozhzhevykh organizmakh.

[Influence of ultrasonic waves upon the sterol content in yeast organisms].

Zhurnal Obshchei Biologii, vol. 17, no. 4. pp.517-520. July/Aug. 1956. 442.8 Z6

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It has been indicated in previous reports (Medvedeva and El'piner, 1955; El'piner, 1955) that ultrasonic waves produce a dissimilar biological effect upon different types of yeast cells. Some of them (endomycetes) are extremely sensitive to this type of energy; others (saccharomycetes), on the contrary, are very resistant in the field of ultrasonic fluctuations. We judged the resistance of yeast cultures on the basis of data concerning the survival of cells exposed to sound. It was assumed that, exposed to the action of ultrasonic waves, biological objects suspended in a water medium either are subjected to rough mechanical destruction, or they remain uninjured. The authors mentioned above have, however, established that the action of ultrasonics is not limited only to a mechanical explosion of cells and cellular structures; it has been observed that exposure to sound had caused finer physico-colloidal changes in the cell content that do not always lead to the destruction of the organism. Such changes occur even in cases in which the biological object proved resistant to ultrasonic action.

The physico-colloidal changes in intra-cellular elements that are registered by cytological methods are, evidently, accompanied by a "shat-

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tering" or "loosening" of the molecular complexes of submicroscopic cellular structures. This is evidenced by the increased activity of enzymes connected with cellular structures which was caused by ultrasonic waves. Thus, for instance, the activity of invertase in Saccharomyces globosus and Endomyces magnusii (Oparin, Gel'man and El'piner, 1954) and of cholinesterase in the nerve tissue (El'piner and Dvorkin, 1956) is increased under the influence of ultrasonic waves. This is evidenced also by data cited in the present report concerning the influence of ultrasonic waves upon the isolation of ergosterol (provitamin D_2) from yeast cells.

We used in our investigations the following yeast cultures: Saccharomyces cerevisiae, Saccharomyces carlsbergensis and Saccharomyces carlsbergensis Frohberg. The ergosterol quantity was determined by the method of Heiduschka and Lindner (1929) as modified by Proskuriakov, Popova and Osipov (1938). Yeast cultures were grown on a must-agar culture medium for a period of 2 days [48 hours]. Then the yeast cultures were pressed and a determined suspension (1-2 gm) was used for analysis. The yeast bulk that was utilized was pulverized with sand and then treated with 25-30 ml of 5% alcoholic alkali [spirtovaia shcheloch']. The process of saponifying yeast cells was accomplished in a water bath in the course of 6 hours.

We exposed the yeast cells to ultrasonics in measuring flasks which were submerged in a so called ultrasonic fountain. Exposure to sound was accomplished in 2 frequencies: 740 and 380 kilocycles per second. The radiator of ultrasonics was a piezoquartz slide 60 mm in diameter. The intensity of ultrasonics was 10 watt/cm^2. The duration of exposure to sound was 45 minutes.

Yeast cells suspended in 5% alcoholic alkali were exposed to sound

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in the first experiments. Immediately after the exposure, this suspension was subjected to saponification in a water bath.

Further the yeast suspension was exposed to ultrasonics in a water medium. In this case the yeast cells were filtered after the exposure and a determined yeast suspension was saponified by the method indicated.

The results of our investigations are submitted in table 1.

Table 1.

Influence of ultrasonics upon the ergosterol content in different yeast cultures (a 2-day culture)

Yeast culture	Quantity of ergosterol in %		Increment of ergosterol in %
	Prior to sound exposure	After sound exposure	
Saccharomyces cerevisiae	1.07	1.80	68
	1.09	1.72	58
Saccharomyces carlsbergensis	3.06	4.00	30
	3.06	4.00	30
Saccharomyces carlsbergensis Frohberg	2.56	5.89	68
	2.75	3.89	41

The table shows that the species and strains of the yeast cells utilized were distinguished from one another by the amount of their ergosterol. An approximately 1% average of ergosterol is ~~found~~ contained in the cells of Saccharomyces cerevisiae, 3% in those of Saccharomyces carlsbergensis, and 2.6% in the cells of Sacch. carlsbergensis Frohberg.

The table also shows that as a result of ultrasonic wave action, the amount of ergosterol in yeast cells had notably increased in all cases: in the cells of Saccharomyces cerevisiae by 60%, Sacch. carlsbergensis by 55% and Sacch. carlsbergensis Frohberg by 40%.

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It must be noted that the increase in the amount of ergosterol in yeast cells occurs regardless as to whether the yeast cultures had been exposed to ultrasonics in an alkaline medium or in a neutral one.

Further it became clear that an increase in the amount of ergosterol under the influence of ultrasonic waves was observed also in cases in which the yeast culture had been exposed to heating preliminarily in a water bath for a period of 30 minutes (table 2).

Table 2.

Influence of ultrasonic waves upon the content of ergosterol in yeast cells (Saccharomyces cerevisiae), that had been preliminarily heated in a bath of boiling water for a period of 30 minutes.

Amount of ergosterol in % in cells that had not been exposed to preliminary heating		Amount of ergosterol in % when cells had been exposed to preliminary heating	
Before sound exposure	After sound exposure	Before sound exposure	After sound exposure
1.15	1.80	1.19	1.80
1.09	1.65	1.22	1.55

Since this method of heating yeast cultures inactivates intracellular enzymes, one can draw the conclusion that an increase in the amount of ergosterol isolated from exposed yeasts, obviously, occurs without the help of cell aenzymes. It, apparently, is a result of a mechanical "shattering" of moleculllar complexes [Begin p.519] the composition of which includes ergosterol. This simplifies the process of releasing the substance referred to in the subsequent (after sound exposure) saponification of yeast cells. It concerns the "shattering" action of the mechanical forces the emergence of which is genetically connected with the very process of dis-

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tributing ultrasonic energy in the exposed medium (displacement and acceleration of particles, alternating pressure etc.). There is little probability that the increase in the amount of the isolated ergosterol is determined solely by chemical processes (primarily by the processes of oxidation), that originate under the influence of ultrasonic waves in a water medium as a result of products that occur due to the break-down of ionized molecules of water in cavitation recesses. Such, probably, is the mechanism of the chemical action of ultrasonic waves upon the individual substances dissolved in a water medium. In this respect the action of the ultrasonic waves is similar to the action of ionising radiation. However, the action of roentgen rays and ultraviolet rays upon yeast cultures is not accompanied by an immediate increase in the yield of ergosterol from irradiated cells (table 3).

Table 3.

Influence of distinct physical agents upon the ergosterol content in yeast cells

Name of physical agent	Amount of ergosterol in %		
	prior to action	after the action	increase
Roentgen rays....................	1.09	1.10	0
Ultraviolet rays.................	1.09	1.09	0
Thermal action	1.09	1.12	0
Ultrasonic waves.................	1.09	1.72	58

Table 3 shows that such an increase was not observed even during the action of a higher temperature upon yeast cultures.

A considerable increase in ergosterol was noted only after the yeast cells which had preliminarily been irradiated by roentgen rays had been allowed to grow some more (Gal'tsova, Meisel' and Seliverstova, 1954). Our experiment has demonstrated that yeast cells that had been

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exposed to sound do not possess such properties (table 4).

After additional growth for a period of 1-2-3 days, preliminarily exposed yeast cells produced no further increase in ergosterol yield.

Table 4.

The amount of ergosterol in sound exposed yeast cells (Sacch. cerevisiae) in relation to the duration of the subsequent growing of cultures

Length of additional growth of culture under investigation	Amount of ergosterol in %		
	in cells without preliminary exposure	in cells exposed preliminarily	increase in ergosterol yield
Original culture	1.20	1.72	43
1 day [24 hrs]	1.22	1.65	35
2 days	1.48	2.00	35
3 days	2.46	2.95	20

We shall, by the way, point out that yeast cells exposed for the purpose indicated (intensity of ultrasonics 6 watts/cm^2, oscillation frequency 885 kilocycles/sec. [Begin p.320] length of sound exposure 40 min.) proved capable of producing an abundant growth.

All of these observations justify the assumption that ultrasonic waves cause physico-chemical displacements in living organisms that are determined by the occurrence of mechanical forces within the cell. The latter, apparently, is strictly specific and characteristic of the given type of energy.

CONCLUSIONS

1. Under the influence of ultrasonic waves the amount of ergosterol isolated from yeast cells increases by approximately 35-60%.

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2. An increase in the yield of ergosterol is observed regardless of whether the yeast cells had been exposed to ultrasonics in an alkaline medium or in a neutral one.

3. The amount of ergosterol increases only if the yeast cells have been exposed to the action of ultrasonic waves. Other physical agents (ultraviolet rays, roentgen rays and higher temperature) do not produce an increase in the yield of the given, biologically active substance.

4. Ultrasonic waves, in contrast to roentgen rays, do not exert any influence upon the ergosterol content in yeast cells when they are allowed to grow a little longer.

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Institut Mikrobiologii i Institut
Biologicheskoi Fiziki AN SSSR

[Institute of Microbiology and Institute
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USSR].

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[Scientific Conference at the Institute of Microbiology, Academy of Sciences, USSR].

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(In Russian)

A 856

Among the vitamins of the B group, vitamin B_{12} has in recent years acquired ever greater importance in the national economy of our country.

Prospects for the practical use of the given vitamin put the question of its commercial production on the agenda. With this objective the Institute of Microbiology of the Academy of Sciences USSR in cooperation with the All-Union Scientific-Research Vitamin Institute explored in 1955-1956 means and methods of increasing the biosynthesis of vitamin B_{12} with the aid of microorganisms.

For the purpose of summarizing the results of the finished work, a scientific conference was held on October 23, 1956. Representatives of a number of scientific-research institutes of the Academy of Sciences USSR, the Academy of Medical Sciences, the All-Union Academy of Agricultural Sciences im. V. I. Lenin, and also of scientific institutes and establishments of a number of Ministries took part in the conference.

Two reports were heard: M. G. Golysheva's "Obtaining vitamin B_{12} by microbiological means with the aid of propionic acid bacteria - Propionibacterium chermani", and N. D. Ierusalimskii's, N. M. Neronova's and I. V. Konova's "Concerning means of increasing the biosynthesis of

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vitamin B_{12} by microorganisms".

In the report submitted by M. G. Golysheva (All-Union Scientific-Research Vitamin Institute) it was indicated that various microorganisms, including actinomycetes, bacteria etc., can be utilized in obtaining vitamin B_{12}. Experimental investigations have demonstrated that propionic acid bacteria are the more promising organisms for the production of vitamin B_{12} on a commercial scale.

With the aid of the given group of microorganisms up to 150-200 gamma [milionth of a gm.] were obtained per gm of bacterial mass under laboratory conditions as well as in fermenters of a 900 liter capacity. Complex organic media composed of maize extract, yeast autolysate, glucose etc. were used as a nutritive substrate.

The possibility of obtaining the vitamin in the form of a concentrate as well as in crystal form has been demonstrated.

The technological scheme developed in obtaining the vitamin may serve as the underlying principle in organising commercial production of vitamin B_{12} by microbiological means.

In the report submitted by N. D. Ierusalimskii, N. M. Neronova and I. V. Konova it is demonstrated that, along with already well known methods (isolation from nature, methods of experimental variation etc.), the biosynthesis of vitamin B_{12} can be increased by adding to the medium specific metabolites (so called precursors) which increase the biosynthesis of vitamin B_{12}.

Such metabolites could be substances included in the composition of the vitamin molecule itself (cobalt, 5,6-dimethylbenzimedazole [dimetilbenzimedazol], 4,5-dimethylorthophenylene diamine) as well as enzyme components which are responsible for vitamin biosynthesis.

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In compounding media prescriptions, it is necessary to take into consideration the change that occurs in the requirements of the organism in relation to its developmental phases.

By using norsulfazole as an antimetabolite in gradually increasing concentrations, the resistance of the culture Bac. megatherium was increased 70 fold by means of 59 passages conducted in the course of two months; as a result, the Bac. megatherium became tolerant to a norsulfazole concentration of 7 mg on a 100 gm medium. However, the bigger the dose to which the culture developed tolerance, the smaller was the amount of vitamin B_{12} which it produced per gm of biomass.

On the basis of the above the conclusion was drawn that vitamin B_{12} is not a product of folic [folievye] enzymes, but that it rather exerts action parallel to folic acid in catalizing the formation of nucleotides. Hence the reporter arrived at the conclusion that in order to increase the biosynthesis of vitamin B_{12} it is necessary to inhibit the synthesis of folic acid, or - still better - to find antimetabolites that exert action directly upon the vitamin biomass.

As a result of the investigations conducted on the selection of rich synthetic or semisynthetic media for the cultivation of Act. álivaceus it has been demonstrated that ammonium salts of succinic, malic, glutaminic, asparaginic and fumaric acids are the most favorable for the growth and synthesis of vitamin B_{12}; it has been established that the salts referred to are not only sources of nitrogen for the given organism, but that their organic portion is also consumed by the organism.

The report has indicated the prospects of using the method of continuous cultivation (method of circulating cultures of propionic acid bacteria in cultivators of the K. N. Dragnov system to increase the out-

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put of vitamin B_{12}. Along with other methods, the given method is recommended for the isolation of more active cultures.

The interesting results obtained and the lively exchange of opinions that followed after the reports had been heard indicated the fruitfulness and disirability of a joint development of topics that can be accomplished on a cooperative basis by academic institutes and scientific-research branch institutes.

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[Institute of Microbiology of the Academy of Sciences USSR]

Vsesoiuznyi Nauchno-Issledovatel'skii Vitaminnyi Institut
[All-Union Scientific-Research Vitamin Institute]

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Anisimov, A. A., and Petrova, R. K.

Uglevodno - belkovyi obmen i uroshainost' pri kornevom usvoenii pochvennoi uglekisloty.

[Carbohydrate - protein metabolism and productivity during assimilation of carbon dioxide from the soil by roots].

Fiziol. Rast., vol. 2, no. 6, pp.558-564. Nov./Dec. 1955. 450 F58

(In Russian)

A
857

Utilization of a method of radioactive indicators made it possible, of late for the Soviet biologists not only to reliably determine the fact of entrance of soil carbon dioxide into the plants through the root system, with its further participation in the process of photosynthesis, but also to uncover many aspects of the biochemistry of this phenomenon (1-6).

Further examination of this problem presents, undoubtedly, both a theoretical and a practical interest, opening up prospects for development of new agrotechnical methods which will be directed to the improvement of nutrition of agricultural crops. One also should keep in mind, that soil carbon dioxide, which is assimilated through the root system, is not only an additional source of carbon for the plants, but also, and this is especially important, it activates the metabolism of the plants (4).

In literature (which is as yet very scanty) on assimilation by the plant roots of soil carbon dioxide there are almost no indications about the matter as to what changes this phenomenon is connected with in the accumulations by plants of individual fractions of carbohydrates, of protein and of other substances. The influence of additional sources of soil

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carbon dioxide on the crop yield of different agricultural plants has not been sufficiently examined yet. Research into these problems was the purpose of experiments which we conducted in 1953-1954 and their results are set forth briefly in this work.

Methods

Experiments were conducted under laboratory conditions with water cultures and under field conditions. In the first case we utilized either Knop's nutrient solution into which we added in one variant $(NH_4)_2CO_3$, 2 g per liter (experiment), and in another - an amount of NH_4NO_3 equivalent in nitrogen (control), or Prianishnikov's mixture in which for the experimental variant we took $CaCO_3$ instead of $CaSO_4$. The pH of the nutrient solution in all variants was brought as near as possible to neutral by addition of 0.1 N solutions of HCl or NaOH. We transplanted into the vessels 6-8 day old sprouts of peas, of sunflowers, wheat or sugar beets. The experiment lasted 5-7 days, after which an analysis of the plants was conducted.

On field sections, as an additional source of carbon dioxide, we introduced into the soil $KHCO_3$, K_2CO_3, $(NH_4)_2CO_3$ (at a rate of 80-120 kg K_2O and N_2 per ha), and on the control sections an equivalent amount of K_2SO_4 or $(NH_4)_2SO_4$ in potassium or nitrogen. In both variants full mineral fertilizer - NPK was given. Soil on the plot was light gray, forest with pH of the salt extraction around 6. Introductions of alkali carbonates, as measurements during experiments in 1953 have shown, slightly shifted the pH to neutral (by several tenths of a unit); that is the reason why in experiments of 1954 we introduced lime as a general background (0.5 t per ha); in this case there was no difference in pH of the soil

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extraction among the variants.

The area of experimental plots was 8-25 m^2. Replication of each variant was triple. Objects for research were sugar beets, cabbage, corn, lettuce and radishes.

In another series of experiments we compared the reaction of $CaCO_3$ and $Ca(OH)_2$ after liming the acid soils. Doses were calculated in such a way that the amount of CaO, which was introduced per unit of area, and, consequently, also the pH of the soil extraction in both variants were similar. Calcium hydroxide for these experiments was taken in the form of comparatively fresh slaked lime, the content of $CaCO_3$ of which did not exceed 3-5%. After introduction into the soil, $Ca(OH)_2$ to some degree, certainly, becomes converted to $CaCO_3$ but that happens already under the influence of carbon dioxide of the soil itself; during this time there occurs no increase in the contents of CO_2. [Begin p.559] Lime was introduced into the plots 10-15 days before planting, and thus it could not have any burning effect on the young rootlets.

This series of experiments was conducted under production conditions in kolkhoz "imeni Kirova", Ketovski district, Gor'ki oblast', and in Gor'ki hothouse - hotbed combine.

Objects of research were: 1. Wheat. Total area of the experimental plot was 30 ha; $CaCO_3$ and $Ca(OH)_2$ were introduced at a rate of 1 t of CaO per ha; 2. Cucumbers. In kolkhoz "imeni Kirova" area of the experimental plot was 0.5 ha; $CaCO_3$ and $Ca(OH)_2$ were introduced at a rate of 2 t CaO per ha. In the hothouse combine the area of experimental plot was 1,500 m^2 under glass; $CaCO_3$ and $Ca(OH)_2$ were introduced at a rate of 3 t per ha. Replication of variants in all cases was double. Evaluation of sugars, starches, total and protein nitrogen was conducted in fixed

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material; determination of sugar was done according to Hagedorn-Jensen, of nitrogen - according to Kjeldahl. Replication during determination of carbohydrates (in materials from each plot) was quadruple, of nitrogen - double.

D. Fusina, S. Irzhak, L. Kondakova, L. Novikova and L. Kasatkina took direct participation in conducting of the experiments.

Experimental Data

Contents of monosaccharides, of saccharose, and of polysaccharides

Introduction into the soil or into the nutrient medium of an additional source of carbon dioxide caused, as a rule, a reduction of the monose and saccharose content in the leaves of experimental plants (tables 1, 2 and 3).

Table 1.

Contents of sugars in sprouts of sugar beets (in % to dry weight) (water cultures, Prianishnikov's mixture)

Experiment chart	monoses	saccharose	Amount of soluble sugars
$CaSO_4$ (control)	3.07	1.33	4.04
$CaCO_3$	2.94	0.36	3.30

Table 2.

Contents of sugars in cabbage leaves (in % to dry weight) Field experiment, planted on April 15.

Date of analysis	Monoses		Saccharose		Amount of sugars	
	$(NH_4)_2SO_4$	$(NH_4)_2CO_3$	$(NH_4)_2SO_4$	$(NH_4)_2CO_3$	$(NH_4)_2SO_4$	$(NH_4)_2CO_3$
June 8	5.40	5.04	19.60	10.60	25.00	15.64
June 11	5.76	5.28	9.60	7.00	15.36	12.28
June 14	10.72	12.08	12.50	10.70	23.22	22.78

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Similar regularity was discovered by us during evaluation of the content of sugar in leaves of corn (comparison of $Ca(OH)_2$ with $CaCO_3$) and in several other experiments.

Reduction of content of sugars in leaves during an introduction of carbonates into the soil can be explained by the biochemistry of root assimilation of soil carbon dioxide and its role in the nitrogen nutrition of plants. As Kursanov has pointed out (1-4), the role of soil carbon dioxide in the protein metabolism consists in carboxylation of products of partial decomposition of sugars, which are formed by the roots, in the cycle of tricarbonaceous acids which leads to the formation of ketonic acids which are the main acceptors of ammonium nitrogen. Soil carbon dioxide, assisting in the formation in the roots of amino acids from organic acids, facilitates a much stronger expenditure of organic acids proper as well as sugars, which entering from leaves and roots are the initial material for the formation of acids.

Monosaccharides and the saccharose of the leaf tissues are the most mobile forms of carbohydrates. That is the reason why we observed lessening of their contents during the introduction of additional sources of soil carbon dioxide. [Begin p.560] At the same time the latter increases the activity of photosynthesis. As analyses have shown, the content of carbohydrates in plants increases at the expense of sugars and of polysaccharides in fruits, seeds, root crops. Thus, in the experiment with liming of an acid soil prepared for wheat (kolkhoz "imeni Kirov") the seeds contained at the time of full ripeness 58.2% of starch on the plots with $Ca(OH)_2$ and 67.3% on plots with $CaCO_3$.

During an experiment with sugar beets, in 1953, the contents of sugar (after 7 minutes of hydrolysis) in roots in the variant with K_2CO_3

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[with a nitrogen background in the form of $(NH_4)_2SO_4$] was 15.81%, and in the variant with K_2SO_4 - 15.66% (with the same background). There was a much greater difference between variants with a nitrogen background in the form of NH_4Cl: in the variant with K_2CO_3 - 15.61%, and with K_2SO_4 only 11.92%.

Table 3.

Contents of sugars (monoses and saccharose in leaves of cucumbers (in % to dry weight).
Experiment in the hothouse combine

Experiment chart	Data of analysis			
	June 11	June 24	July 2	July 15
$Ca(OH)_2$ (control)	5.98	3.62	3.60	2.80
$CaCO_3$	1.46	2.64	2.64	1.70

During an experiment, in 1954, introduction of potassium bicarbonate under sugar beets increased the saccharinity of roots up to 16.7% compared to 15.2% in the control.

A similar regularity was also noted when evaluating individual fractions of carbohydrates in cucumber leaves (table 4).

Table 4.

Contents of carbohydrates in leaves of cucumbers (in % to dry weight).

Date of analysis	Starch and hemicelluloses		Starches, hemicelluloses and sugars	
	$Ca(OH)_2$	$CaCO_3$	$Ca(OH)_2$	$CaCO_3$
June 11	2.32	8.42	6.50	9.88
June 24	3.62	8.08	7.14	10.92
July 2	2.24	5.91	5.74	8.55
July 15	0.52	7.54	3.52	9.24

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Assimilation of total and of protein nitrogen

Results of analyses, conducted by us, attest to a positive influence of supplemental sources of soil carbon dioxide on the accumulation of proteins and of other nitrogen containing substances (tables 5 and 6).

Changes in the content of total and of protein nitrogen after the introduction of carbonates into the soil also can be explained in connection with the role of soil carbon dioxide in nitrogen metabolism of plants. Carboxylation of products of partial decomposition of sugars in roots in increasing the amount and variety of keto acids, by that selfsame action is conducive to the formation of amino acids and assists in the accumulation of both total and protein nitrogen. [Begin p.561]

Table 5.

Influence of carbonates on accumulation of nitrogen in leaves.

Date of analysis	Variant of the experiment	Total nitrogen in % to dry weight
	Cabbage (field experiment in 1955)	
July 5	$(NH_4)_2CO_3$ (experiment)	5.07
	$(NH_4)_2SO_4$ (control)	4.30
July 11	$(NH_4)_2CO_3$ (experiment)	5.47
	$(NH_4)_2SO_4$ (control)	5.41
July 14	$(NH_4)_2CO_3$ ((experiment)	5.82
	$(NH_4)_2SO_4$ (control)	6.19
	Corn (field experiment in 1955)	
August 11	$CaCO_3$ (experiment)	3.56
	$Ca(OH)_2$ (control)	3.41
	Peas. (10-day old sprouts from vegetative vessels, in 1953)	
August 8	Knop's solution + $(NH_4)_2CO_3$ leaves	6.22
	Knop's solution + $(NH_4)_2CO_3$ cotyledon	3.30
	Knop's solution + (NH_4NO_3) leaves	6.18
	Knop's solution + (NH_4NO_3) cotyledon	2.70

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Table 6.

Content of total and protein nitrogen after liming the soil, $CaCO_3$ and $Ca(OH)_2$ (in % to dry weight)

Date of analysis	Object of examination	Total N		Protein N	
		$Ca(OH)_2$	$CaCO_3$	$Ca(OH)_2$	$CaCO_3$
June 30	Wheat, seeds	2.29	2.64	2.05	2.30
June 30	Wheat, leaves	3.09	4.25	3.01	3.25
July 3	same	3.77	3.98	2.66	2.94
June 3	Cucumbers, leaves	3.98	4.05	3.39	3.60
June 16	same	4.26	4.26	4.21	4.07
June 30	same	4.56	4.70	4.20	4.30

INFLUENCE OF ADDITIONAL SOURCES OF SOIL CARBON DIOXIDE ON YIELDING CAPACITY OF EXPERIMENTAL PLANTS

In almost all experiments, conducted by us, introduction of additional sources of carbon dioxide gave an increase in the yielding capacity of experimental plants. Thus, in an experiment with liming of an acid soil in kolkhoz "imeni Kirova" on an area of 30 ha the following yield of spring wheat was obtained by variants:

	In c/ha	In %
Control (acid soil)	6.45	-
$Ca(OH)_2$	6.41	100
$CaCO_3$	7.52	117

The low yield in all variants is explained by unfavorable climatic conditions in summer of 1954. Somewhat similar data were obtained also in an experiment with cucumbers in Gor'kov hothouse combine on [Begin p.562] limed soil mixture used for frames on an area of 0.2 ha. The following yield of cucumbers was obtained from 100 m^2 of frames:

	In kg	In %
$Ca(OH)_2$	572.6	100
$CaCO_3$	645.2	112.7

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As was pointed out previously, the pH of the soil extraction and the amount of the added CaO per unit of area in both variants of these experiments were similar. Rise in yielding capacity was also recorded after the introduction of potassium and animonium carbonates (in comparison with sulfates of these cations) in experiments on small plots (table 7).

Table 7.

Influence of additional sources of soil carbon dioxide on the yielding capacity of agricultural crops

Experimental Scheme	Yield of roots in kg/m^2	Yield of roots in %	Yield of sugar in kg/m^2	Yield of sugar in %
Sugar beets (experiment in 1953)				
K_2CO_3 on background of $(NH_4)_2SO_4$	4.30	107	0.60	111
K_2SO_4 on background of $(NH_4)_2SO_4$	4.00	100	0.54	100
K_2CO_3 on background of NH_4Cl	4.76	110	0.65	128
K_2SO_4 on background of NH_4Cl	4.30	100	0.51	100
Sugar beets (experiment in 1954)				
$KHCO_3$	2.77	105	0.46	115
K_2SO_4	2.64	100	0.40	100
Radishes, Moscow variety, hotbed (experiment in 1954)				
$(NH_4)_2CO_3$	1.76	110	-	-
$(NH_4)_2SO_4$	1.60	100	-	-

In an experiment in 1954, the yield of green mass of Romaine lettuce, "Parizhskii" variety, when additional source of soil carbon dioxide was introduced proved to be as follows:

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	In kg/m^2	In %
$(NH_4)_2CO_3$	3.85	113
$(NH_4)_2SO_4$	3.42	100

It would be wrong to think that increase in yield, when carbonates are added to the soil, result only because of the additionally assimilated carbon dioxide. The inaccuracy of such an assumption can be easily seen from simple calculations. Thus, in an experiment with sugar beets, in 1954, into the soil, together with potassium bicarbonate, about 5 g of carbon was added per 1 m^2. Yield of sugar on these plots exceeded the crop on plots with potassium sulfate in amount of 60 g/m^2, which corresponds approximately to 30g of carbon. Thus the content of carbon in the increase of the yield exceeded by many times the amount which was introduced into the soil together with the carbonate.

Increase of the yield during root assimilation of soil carbon dioxide must be regarded as a result of activation of the whole metabolism (4), the same as during an additional introduction into the soil of elements of mineral nutrition in the form of specific fertilizers.

Introduction of carbonates into the soil did not produce a positive effect in the increase of yielding capacity. In only two experiments, among those which we conducted for two years. [Begin p.563] In one of them we compared the activity of $CaCO_3$ with $Ca(OH)_2$ during liming of the soil for cucumbers. Manure 60 t per ha, was introduced as the general background. Manure in such a dose is a more significant source of soil carbon dioxide than $CaCO_3$. That is why on such a background we did not uncover any differences in the yield between variants with $CaCO_3$ and

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$Ca(OH)_2$.* In another experiment we examined the reaction of ammonium carbonate and of sodium bicarbonate on cabbage. These salts were added directly into each hill when transplanting the sprouts (5 g of ammonium carbonate or 5 g of sodium bicarbonate under each plant). Already after one week it was possible to see that on plots with carbonates seedlings did not take as good, there was more "falling out", that is more plants perished. The plants which remained on plots with $(NH_4)_2CO_3$ developed much worse, gave a smaller yield than in the variant with $(NH_4)_2SO_4$ although the amount of introduced nitrogen in both cases was similar. One can suppose that in the given case when carbonates were added to each hill a toxic reaction on the plants took place due to a local foci of alkalinity.

A peculiar reaction on sugar beets was produced by potassium bicarbonate in a small-plot experiment in 1954. Measurements of leaves in the first half of vegetation have shown that the plants on plots with potassium carbonate developed better than on plots with potassium sulfate. But at the end of the vegetation period the differences in size and outer appearance of tops were in favour of the control plots (that is with potassium sulfate).

Leaves of plants, under which $KHCO_3$ was introduced, were not only smaller in size, but also differed by a much paler coloring, and in many cases they even started to turn yellow. If the average weight of tops of 10 plants on plots with K_2SO_4 was 1.42 kg then in a variant with $KHCO_3$ it was only 1.18 kg. But the yield of roots, on the contrary, was greater in the variant with $KHCO_3$ (see table 7). Grinfel'd also observed a de-

* In our other experiments we did not introduce any manure into the soil, and only in an experiment with cucumbers, in the hothouse combine, manure was added in small amounts to the mixture used for frames.

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crease in the size of the lamina and of the weight of tops of sugar beets at the introduction of potassium carbonate. The author explains it by the fact that additional soil carbonate feedings decrease, to a certain degree, a necessity of development of large leaf surface for collecting carbon dioxide from the air. We are inclined to think that, under conditions of our experiment, potassium bicarbonate, being an additional source for soil carbon dioxide at the same time produced a depressing influence on sugar beets as an alkaline carbonate (in a dose of 50 g per 1 m^2). This depression began to appear during the second half of the vegetative period and told first of all on leaves. This was reflected not only in the outward appearance of leaves (they turned yellow in some places), but also in the trend of biochemism: the amount of nitrogen containing substances decreased sharply, formation of proteins was slowed down, monosaccharides accumulated.

Thus the problem about the influence of additional sources of soil carbon dioxide on the yielding capacity of plants cannot be considered in a simplified way or await positive effect under any conditions. The reaction of each additional source of soil carbon dioxide must be studied separately for each specific crop under specific conditions.

Conclusions

1. Introduction into the soil of carbonates of potassium, ammonium and calcium reduced the contents of monoses and of saccharose in leaves of experimental plants, but increased the amount of sugars and of polysaccharides in tubers, seeds and fruits as well as of polysaccharides in the leaves.

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2. Additional sources of soil carbon dioxide react positively on the accumulation of the total and protein nitrogen. [Begin p.564].

3. Carbonate and bicarbonate of potassium and carbonate of ammonium increased the yielding capacity of experimental plants on the average by 10-15% as compared to sulfate salts of these cations. A similar effect was obtained also at the introduction of $CaCO_3$ as compared to $Ca(OH)_2$ when liming acid soils.

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A problem of great national importance.

Vest. Sel'skokhos. Nauki, vol. 2, no. 7.
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(In Russian)

The Soviet people are getting ready for the 40th anniversary of the Great October Socialistic Revolution with new successes in the struggle for the realization of historic decisions of the 20th Congress of the Party.

The Great October Socialistic Revolution opened a wide scope for development of the production powers in our native country. Following Lenin's way, the Soviet people, under the leadership of the Communist Party, transformed their country into a powerful industrial state and reformed agriculture on socialistic principles. By 1957 USSR industry, when compared to prerevolutionary time, increased more than 30 times, and compared to 1940 - almost four times. No capitalistic country ever knew or knows such high tempos of development.

Industrialization of the country permitted us to arm our socialistic agriculture with a powerful modern technique. At the present time there are working on fields of kolkhozes and sovkhozes over one and a half million tractors (according to information from 15 different sources), about 360 thousand combines, and millions of other agricultural machines.

A kolkhoz system, which was formed according to Lenin's cooperative plan, at its roots, has transformed the basis of production and the mode of life of tens of millions of farmers along new socialistic lines, and opened up a wide pathway to a prosperous and cultured life to all workers in Soviet villages.

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Experience in development of socialistic farming in kolkhozes confirms the great vitality of the kolkhoz system and the undeniable advantages of socialistic agriculture over the capitalistic. Our Soviet farmers, having united into kolkhozes and utilizing the advantages of a large collective economy, have attained great successes in the Soviet socialistic production. The greater part of kolkhozes now have become economically strong farms developed all-round. Cost of basic production facilities of kolkhozes is appraised at over than 95 billion rubles, their annual income in 1956 was 94.6 billion rubles, that is, it grew almost double compared to 1953. Socialistic farming of agricultural workmen's associations became a strong basis for the way of life of the members of kolkhozes, for the growth of their material welfare. This was achieved by the selfless work of kolkhoz farmers and because of the growing help by the Government to the kolkhoz villages.

The great possibilities, which are inherent in large-scale socialistic farming were made more apparent after the September [Begin p.4] (1953) Plenum of TSK KPSS when the Party and the Government have planned and are carrying out large-scale measures for improvement in the guidance of agricultural production in strengthening the kolkhozes, MTS and sovkhozes by experienced directing cadres and specialists, in raising the personal material interest of the members of kolkhozes, of workers in MTS and of sovkhozes in the growth of production of agricultural goods. Bringing under cultivation virgin and waste lands was of greatest importance for the lifting up of agricultural economy; so also were the raising of procurement and purchasing prices for agricultural products and the change in the order of planning in kolkhozes and sovkhozes.

All this made it possible to considerably widen the planting areas,

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to sharply increase the production of grain and of other agricultural commodities. Our country never yet gathered so much grain, as was obtained last year. The crop of cotton was also increased, as were those of sugar beets, potatoes, sunflower seeds, and other agricultural crops. The livestock of cattle grew, its productivity rose also, especially in milk. Thousands of kolkhozes and of sovkhozes, of late, have raised their production of milk and meat two times, and many farms even three times and more.

As a result of growth of agricultural production in 1956, as compared to 1953, the procurements of grain in the country increased by 1400 million puds [puds 36 pounds], of potatoes and vegetables by over 3 mln tons, or by 54%, of sugar beets by 36%, of meat - 28% and of milk - 1.7 times; whereas from kolkhozes by over two times.

Successes, which were achieved in agriculture, and good prospects for its development gave a possibility to the Communist Party to set up a new problem of great national importance; in the near future to catch up with the United States of America in the production of meat, milk and butter per capita of population. In the production of milk and butter per capita of population we can catch up with USA already in 1958, and in the production of meat - basically during the current Five Year plan.

Of course, this is not a simple or an easy task. It requires serious effort of all the working people and a wide mobilization of all the reserves. In order to solve this problem we must bring the production of meat and fat up to 21-22 mln t, of milk to 70 mln. t, that is to increase the production of meat about 3.5 times and milk by 40%. Thus, the question is about a big jump in the increase of production of the most important products of nutrition for our people.

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Notwithstanding the complexity and the difficulty in the solving of the problem raised, there is a firm belief that under the leadership of the Communist Party it will be fulfilled with honor.

"Strength of the kolkhoz system, patriotism of Soviet people and Socialistic competition", said Comrade N. S. Khrushchev at a Conference of Agricultural Workers in Leningrad, "will help us to solve this problem in the nearest future."

To this also attests the experience in development of animal husbandry in our country in the course of the last few years. During two years - 1955 and 1956 - the gross production of milk, in all categories of farms, rose almost by 30%, and in kolkhozes by 69%. In several republics and oblast's still more significant results were attained in the increase of milk production. Thus, in Moscow oblast' the kolkhozes, during the past two years, increased their production of milk by 1.7 times and calculating per 100 ha of agricultural lands they brought it up on the average to 225 c. Kolkhozes of Moldavian SSR for 1956 alone increased the production of milk by 60%. In 1956 in Voronezh oblast' the production of milk rose for all kinds of farms by 40%, and in kolkhozes more than one and a half time. Kolkhoses of Dnepropetrovsk [Begin p.5] oblast' in 1956 increased the production of milk by 1.8 times, and Tian Shan oblast' in Kirghis SSR almost by 2 times.

In answer to the appeal of the Central Committee of KPSS a nation-wide movement has developed for a sharp increase in the production of meat and milk.

At a Zonal Conference of Agricultural Workers of Chernozem Oblast's in Voronezh the president of kolkhoz "imeni Kominterna", of Tambov oblast', agronomist, Comrade Andreeva came forward with a remarkable

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initiative. She stated, that the kolkhoz after having carefully studied and weighed all its possibilities decided in 1960 for each 100 ha of agricultural lands to bring up the production of meat to 170 c and of milk to 400 c.

This beginning attests to a remarkable phenomenon of our days. It is hard to imagine that a similar problem would have been considered by any kolkhoz 3-4 years ago. And now thousands of kolkhozes and sovkhozes, whole oblasts, krais and republics are striving for these same indicators. Many of them pledge to increase the production of meat 3-4-5 times during the next 2-3 years.

Agricultural workers of Moldavian SSR made a pledge to bring up their production of meat by the year 1960 up to 155 and of milk to 416 c per 100 ha of agricultural lands. In Krasnodar krai they decided to increase the production of meat, on the whole for the krai, in 1960 to 203 c and of milk to 529 c per 100 hectares of agricultural lands. Production of meat in the krai will rise compared to the year 1956 by 4.2 times and of milk by 2.6 times. It should be noted that in the gross yield of milk per 100 ha of agricultural lands Kuban, already in 1958, will catch up with Iowa - one of the most powerful States in USA in an economic respect.

The problem to increase the production of meat per capita of the population to the level which was achieved by USA is most complicated. At the present stage the leading role in the increase of meat production should be played by swine husbandry. Biological peculiarities of swine permit in a short time to sharply increase their livestock, and, consequently, the production of pork. In order to catch up with USA in the size of meat production per capita of the population we must in the next years bring up the production of pork to not less than 11 mln t as against

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2.6 mln t which were produced in 1956. For this purpose one should considerably better improve the utilization of basic female herds, as well as to more widely utilize the young sows, which bore piglets for the first time, and, thus, significantly increase the yield of offspring.

Experience of the leading farms shows that a correct utilization of basic female herds, as well as young sows, which bore for the first time, makes it possible to obtain yearly on the average from each basic female, 25-30 and more piglets.

As the experience of leading sovkhozes and kolkhozes shows, with a correct organization of fattening, young pigs 6-7 months old reach 100-110 kg of live weight. Fattening of swine must be very intense. Such type of fattening permits to obtain good meat, which is not too fat; it also requires considerably less fodder, labor and expense per 1 kg of increase in weight than during the more lengthy meat fattening, and still more during fat and semi-fat fattening. Bacon fattening must receive a wide distribution in our country, especially in Baltic republics, in many raions of the Ukraine, of the central chernozem area, of the Northern Caucasus, and others.

It is necessary to give more attention to utilization of such progressive methods of swine maintenance, as rearing the young animals and maintaining mature livestock on cheap feeds in summer camps, upkeep of swine, which are being fattened, in large groups in remodeled pig sties, wide use of automatic feeders and automatic drinking troughs during fattening of swine and others. [Begin p.6]

As experience has shown, on large farms introduction of automatic feeders permits to bring up the number of swine, which are serviced by one pig-tender, to 600-800 instead of 120-150 with the usual feeding; to

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considerably raise the increases in weight and at the same time to lower the expenses for feeds and labor per each unit of increase in weight.

An important source for the increase of production of pork in the country is the development in swine breeding by members of kolkhozes, laborers and employees. It is necessary to organize the reproduction of swine in kolkhozes in such a manner that, without hurting their plans, kolkhozes have a possibility to sell piglets to their own members of the kolkhoz.

Great problems are also faced in the field of raising the production of beef. Estimates show that in the course of next few years the production of beef could be increased up to 6-7 mln t, that is 3-3.5 times.

In order to raise beef production to maximum dimensions it is necessary, first of all, to sharply multiply the livestock of large cattle and of cows, to improve the reproduction of the herd and to considerably raise the live weight of cattle, which is slaughtered for meat. In order to attain a considerable growth in livestock of large cattle, it is necessary to liquidate the barrenness of cattle and to greatly multiply the yield of young animals. For these purposes kolkhozes and sovkhozes must organize a large-scale buying of young animals from members of kolkhozes, workmen and employees, who yearly obtain large numbers of offspring. Our problem is to save these offspring and prevent their slaughtering when young. Part of the purchased young animals-heifers - must be used for reproduction of the herd and the other part - young bulls - must be reared and fattened for slaughtering for beef.

For increase of live weight in cattle, which is turned in for meat, the young animals of large cattle must be reared up to a year and a half, and in steppe regions up to 2-2 1/2 years.

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Our country has great possibilities for the organization of ways for putting on flesh, fattening and increase of live weight of cattle, which is being readied for slaughtering. These possibilities can be well utilized only under conditions that putting on flesh and fattening of cattle will be organised with full consideration of local conditions in each zone.

In the region of the south, corn silage is of great importance for cattle fattening. Many farms and scientific-research institutions achieved good indicators by fattening cattle on corn silage.

In Kazakhstan, Kirghiz SSR, in Siberian oblast's in south-east, and in other regions of the country, with large pasture areas, the basic means for the increase of live weight in cattle, which is meant for beef, must be the summer fattening.

A great reserve for the increase in the production of meat of large cattle is a development of beef cattle husbandry in kolkhozes and sovkhozes in remote steppe raions of Kazakhstan, Siberia, lower regions along the Volga river, in North Caucasus and Far East, which have natural feed bases. It is necessary to establish there large specialized farms for beef production and to start breeding early maturing beef breeds of cattle, having organized an efficient utilization of natural forage lands. Under these conditions it is possible to obtain beef of high quality with least expenditures of labor or money.

In the matter of development of beef cattle breeding and improvement of the quality of meat production of great importance is the breeding of cattle of specialized beef breeds: "Kazakhskaia belogolovaia" [Kazakh white heads], Astrakhansk, Shorthorn, Hereford, [Begin p.7] and others, as well as to utilize bulls-producers of these breeds for commercial interbreeding.

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In grain regions of Kazakhstan and of Siberia are found favorable conditions for finishing off the growing and fattening of young animals of large cattle after they have put on flesh on steppe pastures of other regions of Kazakhstan and Siberia. Waste products from the grain industry, silage and other fodder must be utilized for this purpose.

Food industry in USSR produces yearly up to one billion of decaliter of slops and about 15 mln tn of oilcake. Proper utilization of these industrial waste products for cattle fattening appears to be a big reserve in the matter of expanding the production of beef in the country.

It is necessary to seriously think about the production of beef in regions of milk and milk - beef cattle growing. Apparently it would be expedient to have on large-scale farms, along with milk farms, also farms for beef cattle for growing and fattening young animals for beef production.

Production of mutton should be an important source for extending meat supplies. It is known, that the main purpose of sheep breeding is for enlarging the wool production.

Nevertheless, the regions of fine-wooled sheep breeding, which are called upon to supply our country with fine wool, are also the main regions for production of mutton.

The regions of Kazakhstan, of Kirghiz SSR, Central Asia and Transcaucasia, where very valuable breeds of fat-tailed sheep with an outstanding meat - fat productive capacity are centered are of great importance for the production of mutton.

Poultry raising must also occupy an important place in the solving of h the problem for the increase of meat production; the more so because our country has exceptionally favorable conditions for extensive growing of all

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kinds of poultry.

As an example of a successful utilization of reserves in poultry breeding, are the kolkhozes of Staromlinovskii raion of Stalin oblast'. During the last year all the kolkhozes of the raion increased the production of poultry meat by 5 times and produced 5.6 c of poultry meat for every 100 hectares of grain crops.

The main reserve for the expansion of poultry meat production consists, first of all, in a sharp rise of breeding young birds of all kinds and in the organization of their large-scale growing for meat.

At grain sovkhozes and kolkhozes especially in regions of virgin and waste lands, it is necessary to organize specialized enterprises for growing and fattening of chickens for meat all year round.

Growing hybrid birds is of great importance in the matter of increase of production of meat and eggs. It is known that hybrid birds, compared to purebred and to crossbreeds, produce 15-20% more meat and eggs.

In the Ukraine, Kuban, in oblast's of central chernozem zone in White Russia and other regions of the European part of USSR there are many lakes, rivers, ponds and pastures where millions of head waterfowl can be raised. There is a huge number of water reservoirs also in the eastern regions of the country - in Kazakh SSR, in Altai krai, in Novosibirsk oblast'.

It is necessary to expand production of duck meat, especially by raising "green ducklings", 60-70 days old. Kolkhozes of Stalin oblast' during the current year will produce 2 mln ducklings for meat. Goose breeding is of great importance. When raising geese on pastures, with a small additional feeding of concentrates, it is possible to obtain a lot of goose meat, expending for 1 kg of additional weight only 1-2 kg of [illegible]

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In regions of North Caucasus, Transcaucasia, Ukraine and Central Asia it is necessary to organize extensive growing of turkeys.

Big problems are facing us in the raising of milk production. Our country has all the requisites to catch up with the USA in the production of milk per capita of the population already next year.

In order to successfully solve this problem it is necessary to provide a further, more considerable, growth in livestock of cows, as well as an increase of their milk production capacity. Last year the average milk yield per cow in kolkhozes was 1,613 kg compared to 1,000-1,100 kg in prewar and postwar years. This was a result of consolidation of the forage base, and, mainly, the supplying of cattle with corn silage.

Together with the expansion of milk production, the increase of fat in milk is of great importance.

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In order to catch up with the USA in the next few years in the production of animal husbandry products per capita of the population it is necessary to basically improve the production of fodder and supply the full requirement of cattle in various feeds. Creation of a permanent forage base is indissolubly connected with the general development of agriculture.

The natural-economic conditions of our country are very diverse. That is why solving the problem of development of production of fodders for different regions must be conducted individually. That which is useful and necessary under one condition can be unsuitable and even harmful for others. A pattern for agriculture and conducting it according to

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one scheme for the whole country can only bring harm to it. Working out scientifically based systems of agriculture by taking into consideration the peculiarities of various regions and zones of the country is a most important problem and in this work our scientists have to take quite an active part.

Only with full utilization of the possibilities and reserves which are to be found in kolkhozes and sovkhozes, and on the basis of utilization of scientifically developed systems of agriculture for each zone will it be possible to successfully solve the new, major problems which were set before the rural economy. Yet, there are serious shortcomings in developed systems for agriculture. The principal one is - insufficient revealment of reserves and possibilities in agriculture, especially in the field of animal husbandry. Scientific-research institutions and zonal commissions in localities must remove the defects and finish the development of systems of agriculture for all the zones in the nearest future.

In a successful solving of the proposed problem - to catch up with the USA in the production of meat, milk and butter per capita of population - a great role belongs to agricultural science. The duty of Soviet scientists is to actively enter into this public matter and help the hard-working rural population to solve this historic problem in the shortest possible period. Our scientists must work out the most effective measures, which will guarantee a multiplication of numbers of cattle livestock and the raising of their milk and meat productive capacities, suitable to conditions of various agricultural zones of the country. Work must be widened in the field of improvement of the existing breeds of agricultural animals and of raising the quality of animal husbandry production.

Working out problems directed to enlarge the productive capacity of

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workers on animal husbandry farms to lowering the cost of production, and finding out more efficient forms for the upkeep of agricultural animals is of great importance. [Begin p.9]

It is also necessary to study theoretical questions for the improvement of breeds, the phenomena of heterosis during commercial cross-breeding, regularities in growth and development of agricultural animals, increase in fertility and liquidation of barrenness. It is also necessary to develop more determinedly the questions about utilization in animal husbandry of antibiotics, microelements, hormone preparations and other new measures for influencing the animal organism.

The researches in the field of physiology of nutrition of agricultural animals, with a new outlook for a more effective utilization of feeds as well as use of cheap synthetic feeding substances are also of very grave importance. Great problems face the workers in veterinary medicine in the liquidation of diseases of agricultural animals.

Scientific workers, who conduct research in agriculture and plant growing, must help the agriculturists, as well as the leaders of MTS, of kolkhozes and sovkhozes to bring into action all the reserves, to organize an effective utilization of local and mineral fertilizers, introduction of highly producing varieties, to raise the level of agrotechnics, to utilize effective means for the control of pests and diseases of plants, and others.

Important problems are facing scientists in the field of hydrolic engineering and amelioration. It is possible to considerably enlarge the forage areas and increase the harvest of fodder by means of bringing under cultivation new lands, particularly the highly fertile bottom and swamped lands and the peat bogs.

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With the increase in livestock of cattle in our country the problem of raising the efficiency of workers in animal husbandry will grow in importance with every passing year. It will be possible to solve this problem only by extensive mechanization of all the processes of animal upkeep, of milking, preparation and distribution of feeds, water supply, and so on.

In connection with the raised problems it is necessary to considerably improve the scientific research in agricultural economics, especially in the field of animal husbandry.

A resolution which was taken by the Central Committee of KPSS and by the Soviet of Ministers of USSR "About revocation of compulsory deliveries of agricultural products to the Government by the members of kolkhozes, workers and employees produced on their farms" is of greatest political and economic importance. This edict has been received by the hard-working men in the villages with great satisfaction as a new and vivid testimony of the tireless care of the Party and of the Government about the continuous improvement of material and cultural conditions of life of the working people, as a bright testimony of strengthening of the economic might of our country. This measure became possible thanks to the victories of socialistic industry and socialistic agriculture; as a result of huge successes, which were attained by kolkhozes and sovkhozes in a development of social production.

That is the reason why the Soviet patriots, when discussing the resolution of the June Plenum of TS KPSS, speak with anger and indignation about dishonest attempts of participants of the antiparty group, Malenkov, Kaganovich and Molotov, who denied the achieved practical results in the rise of agriculture. Only miserable renegades, who lost touch with the

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life of the Soviet people and its aspirations,foes of socialism did not see and do not want to see our achievements in the field of agriculture.

The Central Committee of KPSS and the Soviet Government constantly look after the flourishing of agricultural science in our country. It is a duty of all scientists to make a valuable contribution to the public matter for a sharp further advance in animal husbandry. [Begin p.10]

It is necessary more strongly to attract to active participation workers of the agricultural higher institutes of learning for the realization of the proposed work program, to activate the work of oblast', krai and republic experiment stations, which are called upon to bring direct scientific advice to kolkhozes and sovkhozes in the field of their activity.

While actively helping the kolkhozes and sovkhozes to fulfill their obligations at the proper time, the scientific institutions must conduct at the same time theoretical development of the basic problems for the growth of agriculture and its most important branch, animal husbandry, trying to find and testing new ways and means, which would help in further development of agricultural productive forces.

Expansion of scientific works, which are directed to a sharp rise in animal husbandry, will be a serious step ahead in the development of agricultural and biological sciences.

Helping kolkhozes and sovkhozes in an economic competition with USA in the production of animal husbandry products our scientific institutes, in all fields of agriculture, have the possibilities for taking a leading place in agricultural science.

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[Atomic energy in agriculture].

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Of late, in USSR, scientists examine the possibilities for utilization of nuclear radiations in the national economy. Several papers were set forth to report the obtained positive results and were read at the Scientific-Technical Conference.

Biochemical transmutations in potato tubers were examined and it was found that sprouting of potatoes can be retarded by the action of gamma radiations. Depending on the variety of the potatoes, conditions and time of the year, the intensity of the dose of radiation ranges from 8,000 to 10,000 roentgens. For instance, after radiation of potatoes, Lorkh variety, in the fall with a dose of 10,000 roentgens of gamma rays Co^{60}, they kept well during a course of a year in the cellar: total losses and waste did not exceed 10%.

In another work the character and intensity of changes of physico-chemical and taste properties of food-stuffs (beef, fish, mashed carrots, and others) which occur in them after radiation treatments were evaluated. It proved to be that doses of an order of 2 mln roentgens guarantee the

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* According to materials of the All-Union Scientific-Technical Conference on Utilization of Isotopes and of Radiation in Science and Agriculture, April 4-12, 1957.

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sterility of products, but they cause undesirable taste changes. Lowering the dose to 1.5 mln roentgens does not produce full sterilization and the period of preservation is reduced to 3-4 months, but the changes in physico-chemical and taste properties were insignificant. With doses of 300-500 t thousand roentgens the period of preservation is limited to one-three weeks, but the natural properties of products remain almost unchanged.

Radiation with gamma-rays of Co^{60} leads to a faster ripening of grape wines and 2-3 months after radiation the flavor improves and valuable taste qualities are developed in wine.

With the aid of radiation, a new line of mulberry silkworms was obtained, whose offspring are tagged according to sex. In the produced species of silkworm, at the egg stage, all the male individuals are white and the female are of black color. An unerring determination of the sex in mulberry silkworms will permit the industry to raise only male individuals, which produce more silk by about 20-30% and are 10-15% more viable than the females. In this way the silk industry, without additional expenses can obtain 20-30% more raw materials. Nuclear radiations proved to have prospects for sericulture in killing the chrysalises and by conservation of cocoons of the mulberry silkworm. The heat methods which are now utilized for killing the chrysalises and for drying the cocoons are very laborious and impair the quality of the cocoon thread and thus the yield of raw silk. The radiation method for killing the chrysalises of silkworms does not deform the cocoon and does not change the mechanical properties of the thread. As a result of this the yield of raw silk is increased considerably and the irradiated cocoons keep well under ordinary storage conditions.

Gamma-rays can be utilized as a means for control of insects, pests of the stored grains. Irradiation with a comparatively small dose, of an

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order of 10,000 roentgens, leads to full sterility, or to fatal defects in the offspring of the irradiated parents, and to hastening the extinction of curculionidae bettles, which are the basic grain pests during the period of its storage, at all stages of their development.

An American scientists, Professor Homberg, gave a lecture, during which he reported the results of his research on dehelminthization of meat products by radiation. As during sex sterilization of granary pests (curculionidae beetles) for the irradiation of helminths' larvae a sufficient dose is of an order of 10-20,000 roentgens.

The work on sterilization by radiation of medical preparations can serve as a last instance for practical utilization of radiations. It is obvious, that the results of this research can also be useful in the practice of production of veterinary preparations.

Radiation treatment with doses of an order of 1.5 mln roentgens leads to full [Begin p.146] sterilization of bacterial preparations (vaccines and antitoxins), of culture media and for disinfection of bacterial preparations.

At the meetings of the Radiobiological Section problems were discussed on examination of the mechanism of the action and utilization of nuclear radiation for increasing the productiveness of plants and/of microorganisms. Materials were presented, in the reports, which confirmed that small doses of radiations, or preplanting treatments of seeds with solutions of radioactive isotopes, stimulate the growth, the accumulation of the green mass and hasten the time of ripening of plant seeds; they also raise, in leaves, the accumulation of biologically active substances (ascorbic acid, chlorophyll).

Cytological analysis of plants shows that the effect of radiostimulation is connected to an increase in tempo$\cancel{e}$s of cell division, and, in

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the first place, in nuclear division. Inhibition in the growth of plants under the influence of large doses of radiations is characterized by the presence of chromosome chiasms which require for their realization a great deal of energy, concentrated in time and space. It is assumed that radiostimulation occurs as a result of primary radiation-chemical effects and by the initially induced chain reactions caused by them which lead to the increase of enzyme activity of the cells. Indeed, in another work about preplanting treatment of seeds of tomatoes and of cotton with solutions of radioactive isotopes of phosphorus (P^{32}) and iron (Fe^{59}) raising of activity of dehydrase enzymes (catalases, peroxidases) and increase in the amount of green mass was noted. Histochemical analysis in irradiated corn seeds indicate a much earlier conversion of starch into dextrin and of dextrin into sugar compared to the control, which can be considered to be an intensification of hydrolytic activity of enzymes under the influence of radiation.

Several lectures were given over to practical measures for utilizing the radiations for raising the yielding capacity of agricultural crops.

Studies of the reaction of nuclear radiation on yeast organisms were conducted by morphological and physiological methods. At a dose of one million roentgens, which leads to full cessation of multiplication of microorganisms, the structural organization of a microbe cell is also considerably disturbed. Irradiated microbes retain the function of growth, partial ability for respiration, fermentation of fat and formation of sterol. Thus, different functions of the metabolic activity of microorganisms have different resistance to the activity of nuclear radiation. An adequate choice of a dose made it possible to increase the formation of ergosterol. Yield of ergosterol increased almost 4 times (as compared to the control) with a combined utilization of the influence of radiation and

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of a unilateral carbon nutrition of production strains of yeast.

Soviet scientists began to utilize radioactive isotopes during development of scientific bases for animal breeding. Let us cite the results of some works which were presented to the Conference. It is known that in different species of agricultural animals the phosphoro-calcium exchange is not sufficiently examined, the correlation between the productiveness of the animals and the speed of metabolism are not made clear; the relationship between the feed rations, which are given to the animals, and the metabolic processes which take place in their organisms are not clear at all. Radioactive isotopes helped to uncover the regularities of these processes.

Up to the present time it was assumed that for the formation of the shells of chicken eggs the main source of calcium was the nutritive calcium, which enters the blood directly from the alimentary tract. With the aid of radioactive isotopes of calcium data were obtained which give reason to think that the skeleton is the sole source of calcium for the formation of egg shells. Before being deposited in the shell, all the nutritive calcium enters the skeleton, and only from there its expenditure is strictly regulated by the neuroendocrinic mechanism. The speed of hens' skeleton renewal is in close relation to their productivity. In hens which during the course of two months laid 25 eggs, an almost full renovation (95%) of the skeleton occurred, at the same time in non-laying hens the skeleton was renewed only by half.

The porous bone substance, which fills the hollows of chicken bones is the most active. In this substance the speed of calcium exchange exceeds 4-5 times that of the compact substance. An assumption was expressed about the existance in the bone tissue of different forms

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of calcium, which interchange with unequal speeds.

The obtained data speak about a direct participation of the skeleton in egg productivity of hens, which requires a great demand for mineral provisions in the feeding of laying hens.

In the conducted experiments it was found that in coarse-wooled and in fine-wooled sheep inorganic sulfur, just as is the organic, is well utilized for the synthesis of wool. But one should not think that such an ability to assimilate inorganic sulfur is universal, because, for instance, in rabbits and antelopes it is absent. This fact must be taken into consideration when preparing feed rations for sheep. [Begin p.147]

With the aid of radioactive carbon it was shown, that chlorophyll of green feeds plays a big role as a plastic material during the formation of hemoglobin of the blood. The porphin ring of the fodder chlorophyll passes directly into the hemin of the blood. Direct utilization of chlorophyll for biosynthesis of the blood's hemoglobin explains the effectiveness of the green pastes and of silage as a measure that prevents development of anemia in animals during the winter-spring period.

Prophylaxis and control of the most important skin diseases of animals is conducted basically with drugs. That is the reason why for an efficient utilization of medicinal preparations, depending on the purpose of their use (surface or internal remedies) it is necessary to know the penetrability of the skin of different animals for the most prevalent medicines. The best method for a quick evaluation of pentrability of medicines through the skin of animals proved to be the method of radioactive isotopes.

During numerous experiments with agricultural animals (large cattle, sheep, swine, rabbits) new data were obtained about the way and speed of penetration of certain medicinal preparations through the skin. It was

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ascertained that water, water solutions of medicinal preparations and sulfur containing compounds do not penetrate the unimpaired skin of large cattle. Water solutions of phenol are an exception, because they disrupt the cells of the external epithelium and enter the animal organism. Sunflower and solar oil, oil solution of preparations, as well as organic solvents (alcohols, chloroform and ester) penetrate through the hair follicles along the shafts of hair and through the ducts of oil glands. Not one of the tested preparations entered the skin through the sweat glands and their ducts. The obtained results are important when prophylaxis measures are developed as well as for the control of larvae of Tabanidae, of mange, and other diseases of the skin.

Reports during meetings of the Agrochemistry and Soil Science Section were given over to examination of conditions for the most effective introduction of fertilizers under different agricultural crops.

An isotope method of evaluation of the assimilability of phosphorus (or of another element) from the fertilizer gives more accurate results than the usual chemical method which is based on measuring the difference between the contents of phosphorus in plants of the control and of the fertilized variety. It is known that plants during different phases of their development set forth unequal demands for nutrient substances. For evaluation of various methods for application of fertilizers it is important to know not only the total amount of consumed fertilizers, but also the sources for plant feeding. Such distinct calculation became possible with the aid of radioactive isotopes.

Quantitatively a thesis was confirmed about the fact that the most effective method for creating an increased level for phosphorus feeding of plants during all periods of vegetation is a combination of row ferti-

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lizing with a deep application of superphosphate. Simultaneous introduction of small amounts (3 c per ha) of compost together with the superphosphate improves the utilization of phosphorus. Addition of lime, 5 c per ha, to the mixture of superphosphate and compost lowers the ability of plants to utilize phosphorus from fertilizers. Lowering of the availability of phosphorus to the plants is connected to a decrease of mobility of phosphorus under the influence of calcium in lime. Yet the negative action of lime on the entrance of phosphorus from the fertilizer during its joint introduction with superphosphate depends on the quality of soils; thus, on strongly acid turf-podzol soil a joint introduction of superphosphate, humus and lime improves the utilization of phosphorus by the plants. Direct observations of the entrance of radioactive phosphorus during the first 30 days after sprouting have shown a better utilization of phosphorus from superphosphate in small granules of 1-2 mm. The advantage of small granules (1-2 mm) during row fertilization consists, probably, in their more close grouping in the row, which leads to a greater probability of their meeting with plant roots. On the basis of the obtained data a question is raised about the expediency of introducing some changes into the now existing standard for granulated superphosphate.

Utilization of radioactive isotope of phosphorus P^{32} in agrochemical research caused us to revise our idea concerning the phosphoric process in the soil. It was proven that in places where phosphorus fertilization, of many years standing, exceeded its carrying out by the crop, the plants utilized the soil reserves of assimilable phosphates. There occurs a sort of phosphatization of the soil.

Radioactive tagging, helped to clarify that the notion about harmful retrogradation of watersoluble phosphates in the soil and about a low

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coefficient of their utilization does not coincide with data of the experiment and requires a radical revision. A question is raised for the revision of utilization of phosphoric fertilizers in different regions of USSR.

Several reports were devoted to defining more accurate time and means for application of phosphorus fertilizers under various agricultural plants. [Begin p.148]

As a result of use of P^{32} success was attained in the introduction of much that was new in the examination of additional methods for regulation of conditions for plant nutrition. Leaf feeding of vegetables proved to be especially promising. For instance, phosphorus leaf feeding of tomato seedlings has successfully supplied the plants with mineral nutrition during the first period of vegetation.

The Agrochemistry and Soil Science Section gave considerable attention to problems of application of fertilizers and nutrition of fruit and tree plants.

Intensity of P^{32} assimilation can serve as a reliable indicator of reciprocal action of tree species in forest plantings. From among the examined varieties ash showed the greatest intensity for assimilation of P^{32}, then (in a declining order) follow linden, hornbeam, maple, oak, and the least - birch. Ash competes successfully with other varieties and in mixed plantings assimilates more phosphorus than in pure culture. With a high level nitrogen-potassium nutrition the entrance of phosphorus is lowered during the sprouting period, but beginning with July and up to late fall the intensity of P^{32} assimilation is raised.

When data about the speed of water current in tree plants were defined more accurately it was ascertained that during sunny summer days

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it reaches 1-2 m per minute, and is negligeable during the period of winter rest or during rainy, cold weather. Under arid conditions, during the absence in the soil of available moisture, and the lowering of moisture in wood to 30%, the speed of the ascending flow of water exceeds 18 m per minute.

In experiments with phosphorus leaf feeding of fruit trees sucess was attained in increasing the yield of an apple tree up to 30%. Such an increase in the apple crop the authors explain by raising of intensity in photosynthesis of the tree leaves. Utilization of phosphoric leaf feedings on the background of abundant soil fertilization did not show any changes in the assimilation of P^{32}.

Several reports were given over to the examination of the cycle of substances between the plant and the soil. Facts were cited which pointed to the presence in the plants of processes of movement of phosphorus not alone from the soil through the roots to the leaves but returning back also. Phosphorus which flows in from the soil is not fixed by the plants, but takes part in a continuous renovation of organic compounds in them. Speed of phosphorus movement varies in different plants; for instance, among three tested crops the greatest was in sugar beets, after that in corn and the least in spring wheat.

Of great interest was the work where it was shown that fixation of atmospheric nitrogen proceeds not in the tuberculoid bacteria but in tuberculoid tissue, which represents a regenerated tissue of higher plants (alfalfa, peas, clover). The authors think, that the role of tuberculoid bacteria, apparently, consists of inducing formation of this specific tuberculoid tissue. The cited facts throw light on the role of microorganisms in processes of nutrition and of metabolic activity of the plants in a new way.

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As it is known, one of the main problems of irrigated farming is the control of moisture content in the layer of soil inhabited by roots. An apparatus was suggested for a quick evaluation of moisture in the soil by X-raying a certain layer of it with gamma-rays. The gamma-method is as accurate as the usual thermostatic-gravimetric (method), and it frees the experimenter from extremely laborious and lengthy proceedures. The gamma-snow gage, which is very convenient and even irreplaceable in inaccessible mountain regions is based on the same method.

A method was worked out and the speed of the current of subsurface water, and the permeability of peat soils evaluated with the aid of radioactive isotope of iodine.

The suggested micromethod (with the aid of heavy hydrogen or oxygen water) is of special interest for determination of the relation between the intensity of the entrance of water into the plant and concentration of water in the solution.

The cited instances permit us to come to the conclusion that the Soviet scientists are utilizing, on an ever growing scale, isotopes and radiations in the solution of basic problems of biological and agricultural sciences.

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Trans. A-860
(In full)
vg/M

Kriuchkova, A. P., and Komarova, L. I.

Kormovye drozhzhi kak istochnik vitaminov.

[Fodder yeasts as sources of vitamins].

Gidrol. i Lesokhim. Promysh., vol. 9, no. 5.
pp.6-7. 1956 301.8 G36

(In Russian)

Fodder yeasts contain well assimilable proteins (450-500 g per 1 kg), as well as basic vitamins of B complex and ergosterol, which makes them a valuable source of vitally needed amino acids and vitamins for animal husbandry, poultry growing and wild-beast breeding.

A-860

Increase of nutritive value of fodder by means of adding yeast to it helps in the raising of production of basic products of animal husbandry and of poultry growing (meat, milk, butter and eggs) and in lowering their cost price [1, 2]; helps to improve the quality of products of wild-beast breeding sovkhozes (fur) [3], as well as facilitates artificial propagation of valuable fish, salmon in particular [4].

In connection with development of efficient methods for feeding and examination of the role of individual vitamins in the ration of animals and poultry, requirements were raised for evaluation of the quality of fodder yeast of hydrolytic and sulfite-alcohol plants, and the necessity appears for a more detailed examination of amino acid composition of their protein and content of various vitamins in yeast.

If, previously, yeast was valued mainly as a source of riboflavin (vitamin B_2), then at the present time zootechnicians are also interested in the content in yeast of other vitamins, which are required by the animal

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organism (pantothenic acid, biotin, pyridoxine, and others).

Effectiveness of the use of fodder yeast as a source of riboflavin, according to literary data [5], is seen from table 1.

Table 1.

Chicken rations	Contents of riboflavin in mcg per 100 g	Average weight of chickens, 6 weeks old, in g	Mortality in %
Basic	147	180	8.7
Basic with addition of yeast in %:			
0.25	162	221	4.4
0.5	177	257	0
1.0	207	470	0
3.0	327	589	0
Basic with riboflavin	405	526	0

Greater weight of chickens, during the addition to the feed of 3% of yeast, than with a rich ration, is explained by the fact that yeast contains growth substances which were not yet examined.

From these same data it appears that the chickens, which received a basic ration with an insufficient content of pantothenic acid, all perished (Table 2).

Table 2.

Chicken rations	Contents of pantothemic acid in mcg per 100 g	Average weight of chickens, 6 weeks old, in g	Mortality in %
Basic	111	-	100.0
Basic with an addition of yeast in %:			
1	189	122	78.2
2	267	267	34.8
4	423	489	0
6	579	590	0
Basic with pantothenic acid	1152	526	0

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Such effectiveness in utilization of fodder yeasts points to their great value in poultry growing and to more wider testings of yeast not only as an additional rich protein feed, but also as a source of vitamins, because the addition of pure vitamins to the feed rations at the present time is still very limited. Besides this, it is known, that natural concentrates of vitamins are more active physiologically than are the preparations of synthetic vitamins [6].

Examination of biosynthetic activity of various microorganisms permitted choosing among them very active producers of individual vitamins. Thus, for instance, propionic acid bacteria are producers of vitamin B_{12}, which accumulate up to 4.3 mg of vitamin B_{12} in 1 ml of culture medium. Streptomyces griseus, which form 1.3 mg of vitamins in 1 ml, and others. At the present time among riboflavin producers, are known such "supersynthetics" as Eremothecium ashbyii, Ashbya gossipii, which are being utilized for industrial output of this vitamin. In connection with this the role of yeasts, as a source for individual vitamins, can become modified. [Begin p.6] The value of fodder yeasts consists in the fact that at the same time they are sources of many vitamins and thus their utilization is more profitable economically.

It is known, that yeast contains the greatest amount of group B vitamins in that case when they are grown on media of raw food materials or in mediums with an addition of natural substrates - plant extracts, malt sprouts, molasses, yeast autolyzate. These substances enrich the medium with growth substances and inorganic salts, which can influence indirectly the accumulation of vitamins. Besides this, their influence can consist in the fact that they introduce into the medium the precursors or fragments of vitamin molecules and vitamins, which can be adsorbed by

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the yeast cell and increase the contents of vitamins in it.

Hydrolytic and sulfite-alcohol culture media are specific. Yeasts which are grown on them under production conditions can differ considerably in the content of vitamins from yeasts grown on molasses and on grain raw materials. In this respect, beer and baker's yeast, which were examined the most, differ also in their systematic state from yeasts and yeastlike organisms, which are cultivated on mediums made from nonfood raw materials.

Yet, exactly the fodder yeast, which was obtained from nonfood raw materials can become a very substantial agent for satisfying the great need of agriculture in highly valuable protein - vitamin feeds. That is the reason why the research into fodder yeast of hydrolytic and sulfite-alcohol plants, as a source of vitamins, is of such great interest.

One of the problems of VNIIGS (All-Union Scientific Research Institute of Hydrolysis and Sulfite Alcohol Industry) is the evaluation of the nutritive value of yeast which is put out by plants of hydrolytic and sulfite-alcohol industry as well as to find means for their enriching with vitamins and vitally indispensable amino acids, mainly, sulfur-containing amino acids, among which methionine is of the greatest importance [7].

In 1953 we published results of researches into contents of thiamin, riboflavin, nicotinic and folic acids, as well as ergosterol in fodder yeasts [8]. During further work we evaluated contents of pantothenic acid, biotin (vitamin B_7 or vitamin H), pyridoxine (vitamin B_6, adermin) and vitamin B_{12} in different kinds of fodder yeast.

We examined specimens of industrial yeasts from:

a) Priozerskii cellulose plant, grown on sulfite-alcohol waste liquor - Torulopsis utilis, race C-1. During the period of selection of specimens there was 95-98% of C-1 cells in proportion to the total number of

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yeast cells;

b) Kanskii hydrolytic plant, grown on hydrolytic waste liquor, - Candida tropicalis, race L-2K54. 80 to 85% of these yeasts were contained in inoculators.

c) Krasnoiarskii hydrolytic plant, grown on hydrolytic waste liquor, - Candida Sp., race Kr-9; there were 100% of them in inoculators.

In order to find out how the industrial conditions, mainly, composition of the medium and drying at high temperature, affect the contents of vitamins in yeast, we analyzed, along with the above cited specimens, also those races of yeasts, which were propagated on rich synthetic mediums under laboratory conditions and were dried under vacuum.

The amount of vitamins in fodder yeast was determined by microbiological methods, which are simpler and more practicable for most laboratories, than the chemical, as well as the biological methods (when evaluation of vitamin containing products is conducted directly on animals). Microbiological methods are faster than the biological but at the same time they have its specificity. Of late they received a wide spreading owing to the works of Russian and foreign researchers.

Contents of pantothenic acid in yeasts were evaluated according to a method developed by Meisel, Pomoshchnikova and Trofimova [9]. Yeast Saccharomycodes ludwigii was the indicating organism. Rieder's medium with 2% saccharose, to which biotin, thiamin, pyridoxine, inosite and nicotinic acid were added, was the basic medium.

For a quantitative evaluation of the contents of vitamin B_{12} in fodder yeast as an indicator we utilized Bact. coli culture, strain 113 which is sensitive to this vitamin. We tested a method of seeding the indicator culture in test tubes with a liquid medium containing various amounts of

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the standard solution of vitamin B_{12} or extract of tested yeasts, as well as a method developed by the All-Union Scientific-Research Institute of Antibiotics (the indicator organism was grown on wort-agar in cups). These methods gave very similar results. Data on the contents of B_{12} vitamin in yeast, cited in the table, were obtained by the test tube method. Intensity of bacteria propagation was determined by turbidity of the medium with the aid of an electrophotocolorimeter.

Heating by autoclave was used in order to separate vitamin B_{12} from the protein complex: 1 g of dry yeast was covered with 20 ml of distilled water, pH was set at 5.0 and the mixture was heated in an autoclave at 0.5 atm for 15 min in the presence of sodium nitrite, used as a stabilizer.

We also evaluated the contents of biotin and pyridoxine besides vitamin B_{12} and pantothenic acid in these specimens.

Biotin helps assimilation of proteins and fats by the animal organism, as well as maintains a normal condition in the integument. Contents of biotin in yeast were evaluated by a microbiological method utilizing a yeast-like organism, Endomyces magnusii, which is sharply in need of this vitamin for its development.

Pyridoxine - an antidermatic factor - was quantitatively determined in yeast with the aid of the microorganism Saccharomycodes ludwigii according to a method described by Meisel and Pomoshchnikova [10].

Results of quantitative evaluation of vitamins in fodder yeasts are cited in Table 5.

The obtained data were compared with results of works of other authors on evaluation of vitamins in yeasts and in yeast-like organisms, which were grown on media made of nonfood raw materials, also in baker's and beer yeasts, as well as with results of evaluation in yeasts of other

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vitamins: thiamin, riboflavin, nicotinic and folic acids. Data of the table show that yeasts of various genera and species differ considerably.

Yeasts of Krasnoiarskii Hydrolytic plant showed the greatest activity in biosynthesis of vitamins among yeasts from hydrolytic and sulfite-alcohol plants. In 1g of abs dry yeast from Krasnoiarskii plant 100 mcg of pantothenic acid were found, whereas in yeasts from Lobvinovskii plant, which also belonged to genus Candida, 52.0 mcg of pantothenic acid were contained, and in yeasts from Priozerskii, sulfite-alcohol plant - 21 mcg per 1g of abs dry substance.

Yeasts from Krasnoiarskii plant were richer than yeasts from Lobvinskii plant in biotin, pyridoxine and vitamin B_{12}.

We do not have data of other authors on quantitative evaluation of vitamin B_{12} in cells of yeast-like organisms, which were grown on ligneous mediums, with which we could compare data of our experiments. It is known that this vitamin is practically absent in plant materials, as well as in yeasts of genus Saccharomyces.

As it is seen from table 3, yeasts from one and the same race, which were grown on a rich synthetic medium under laboratory conditions, differed little in the content of vitamins which were obtained under industrial conditions on waste liquors. Only in certain cases, for instance, during evaluation of pantothenic acid in industrial yeasts from Lobvinskii and Priozerskii plants less vitamins were uncovered than in the same races of yeasts obtained in laboratories.

Data of foreign authors about the content of vitamins in yeast of genus Torulopsis and Candida, which were grown on media made of nonfood raw materials [11, 12 and 13] are close to our data which were obtained with yeasts from hydrolytic and sulfite-alcoholic plants. Yeast of genus

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Hansenula contained more panthothenic acid, but had in their cells very little folic acid.

According to literary data, contents of vitamins in baker's and beer yeasts, obtained from raw food materials vary to a very large degree [13,14]. [Begin p. 7]

Table 3 on next page.

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Table 3.

Microorganisms	Yeast specimens	Medium for growing yeast	Contents in mcg per 1g of abs. dry substance							
			Pantothenic acid	Biotin	Pyridoxine	Vitamin B_{12}	Thiamin	Riboflavin	Nicotinic acid	Folic acid
Torulopsis utilus race C-1	Industrial Priozerskii plant	Sulfite-alcoholic waste liquor	21.2	2.8	19.6	Traces	5.6	25.9	415.0	26.4
Ditto	Obtained in laboratory	Synthetic	42.0	2.7	24.8	Ditto	13.8	16.5	302.0	9.8
Candida tropicalis race L-2K (54)	Industrial Kanskii plant	Hydrolytic waste liquor	32.0	1.6	9.0	"	13.0	27.4	-	-
Ditto	Obtained in laboratory	Synthetic	40.0	1.8	34.5	"	-	-	-	-
Candida Sp. race Kr-9	Industrial Krasnoiarskii plant	Hydrolytic waste liquor	100.0	2.7	26.4	0.08	18.3	48.6	326.0	18.0
Ditto	Obtained in laboratory	Synthetic	100.0	3.0	30.3	0.08	-	-	-	-
Torulopsis (1)	Ditto	Sulfite lye	37.2	2.3	33.4	-	5.3	45.0	417.0	21.5
Candida (2)	"	Sulfite-alcoholic waste liquor	-	1.8	-	-	5.5	59.0	600	3.1
Hansenula (2)		Ditto	180	1.7	-	-	8.5	54.0	590	1.7
Saccharomyces cerevisiae (3)	Beer	Food raw materials	42-200	0.8-1.1	23-100	-	60-180	21-80	281-1000	19-30
Ditto	Baker's	Ditto	150-330	0.24-0.8	25-65	-	16-40	25-80	240-700	19-80
Saccharomyces cerevisiae (4)	Beer	"	92-280	-	15-98	-	6-110	20-35	400-1150	16.2-24.6
Ditto	Baker's	"	60-210	-	20-76	-	10-21	32-41	180-420	56.3-76.4
"	After fermentation	Hydrolizate	15-45	-	14-74	-	12-18	16-24	280-430	-
"	Ditto	Sulfite lye	19-36	-	18-56	-	16-24	36	180-270	-

(1) According to data of Wiley, Dubey and others [11]
(2) According to data of Kurch, Cheldein [12]
(3) According to data of Van-Lanen [13]
(4) According to data of Peknice [14]

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Beer and baker's yeasts are richer in pantothenic acid, and in individual cases, in pyridoxine than are the fodder yeasts. The stepped up synthesis of thiamin by the yeast Saccharomyces cerevisiae was detected under conditions of beer brewing, that is at a relative anaerobiosis. Baker's yeast surpassed but little the fodder yeast in the content of thiamin.

Conditions for cultivation and the composition of the culture medium are of great importance for the synthesis of vitamins by saccharomycetes. Thus, results of analysis of yeasts from secreted and fermented substrata of nonfood raw materials - hydrolyzate and sulfite alkali - differ considerably in the content of vitamins from saccharomycetes, which were obtained from raw food substances. They come close in contents of pantothenic acid, thiamin, riboflavin, and nicotinic acid, to yeasts of genus Torulopsis and Candida which were grown on sulfite-alcoholic and hydrolytic media.

The conducted work has shown, that microbiological methods of quantitative evaluation of vitamins, which are based on the utilization of various yeasts and bacteria as indicator organisms are quite suitable for evaluation of vitamin contents in dry fodder yeasts which are put out by hydrolytic and sulfite-alcoholic plants. Besides vitamins, which were uncovered in fodder yeasts previously, thiamin, riboflavin, nicotinic and folic acids, as well as provitamin D_2 - ergosterol, in industrial yeasts from hydrolytic and sulfite-alcoholic plants there were found contents of biotin, pantothenic acid, pyridoxine, and, in individual cases, B_{12} vitamin. Hence, fodder yeast must be evaluated not alone as high-quality protein feed, but also as vitamin preparations, which are able to guarantee normal development of animals and poultry, to increase their productive capacity and prevent many diseases.

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(In full)
vg/M

Kriuchkova, A. P., and Rodionova, G. S.

Vnedrit' v proizvodstvo bolee urozhainye drozhzhi, usvaivaiushchie ksilozu i arabinozu bardy.

[To introduce into production higher yielding yeasts, which assimilate xylose and arabinose from waste liquor].

Gidrol. i Lesokhim. Promysh., no. 4, p.11-13. 1955. 301.8 G36

(In Russian)

Selection of higher yielding species and genera of yeasts, which would guarantee a fuller utilization of organic substances in waste liquor and a greater yield of the biomass, is one of the factors which help in the raising of productivity of yeast shops of hydrolytic and sulfite-alcoholic plants and in the lowering of the cost of production.

Yeasts and yeast-like organisms, which are able to assimilate pentoses and develop in hydrolytic and sulfite-alcoholic mediums vary greatly among themselves in the activity of fission and yield of mass.

In connection with special peculiarities of work of yeast shops, different plants were recommended different species and genera of yeasts(1) mainly from genus Candida, which guarantee a larger yield compared to previously utilized yeasts from genus Torulopsis.

Work of yeast shops as with neutralized so also with acid waste liquor has shown, that yeasts, which were selected from a number of production strains can develop for a long time in inoculators without degenerating and without lowering the output in proportion to the sugar in waste

(1) "Hydrolytic Industry of USSR", 1949, no. 6; 1952, no. 1; 1954, no. 4.

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liquor. They can form new races which are more adapted to development in hydrolytic media, than the initial. Different races of one and the same species of yeasts, which were isolated at one and the same plant or at different plants, also differ in the intensity of accumulation of biomass and give different yields in production.

As a result of introduction of the new technique and of a technological scheme for continuous growing of yeasts, the work of yeast shops of hydrolytic plants has improved and requirements for better qualities of yeasts, cultivated at the plants, have risen. A problem was set before the VNIIGS (All-Union Scientific Research Institute of Hydrolysis and Sulfite Alcohol Industry) laboratory for yeast production, in 1953-1954, to select yeasts, which are able to accumulate biomass in hydrolytic mediums more actively than the ones used at the present time.

This problem was solved by the laboratory by means of selection of best races, which formed during production, and by obtaining new variants of yeasts by a method of directed modification of their natural qualities, as well as by ways of looking for new species produced under conditions of hydrolytic and sulfite-alcoholic plants.

Most yeasts which are cultivated at the plants at the present time make use of xylose alone among the pentoses of waste liquor. At the contents of 0.5-0.7% of sugar in waste liquor, loss of it in the form of arabinose (0.12-0.16%) reflects substantially in the cost of commodity yeasts. That is why when selecting new species and variants laboratory workers aimed at finding such yeasts, which would have this important property for production, the ability to assimilate from waste liquor not alone xylose but also arabinose.

A series of strains, which assimilate arabinose, were found among the number of industrial pentose yeasts. Arabinose variants of yeasts, genus

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Candida, strains L-2 and X-9, were obtained under laboratory conditions.

The article gives a comparative evaluation of different species and races of yeasts in production tanks of various plants where they are propagated in the form of basic cultures or as incidental ingredients.

Examinations of yeasts were conducted on hydrolytic waste liquor with intensive aeration under laboratory conditions in standard apparatus for yeast growing; a periodic, influent method was used for propagation.

As basic indicators for the activity of yeast propagation in waste liquor were taken: degree of utilization of RV (reducing substance) and of organic acids (which were evaluated conductometrically), yield of yeasts in proportion to the given reducing substance, and the quality of yeasts. For a more unbiased evaluation the yield of absolutely dry mass was compared to the yield of "normal" absolutely dry yeasts, containing 50% of protein.

During the first series of tests the production yeasts from Lobvinskii and Khorskii plants, strains L-2 and X-9 from genus Candida were compared with various species of yeasts, which are able to assimilate arabinose. Tests were conducted on waste liquor from Kanskii plant (Table 1).

It is seen, according to table 1, that in waste liquor from Kanskii plant, the production strains of yeasts, which assimilate arabinose differ greatly in degree of utilization of reducing substance and the yield of biomass. The lowest degree of utilization and of the yield of mass were produced by spore-bearing yeasts, SD-6 and L-1, which owing to their ability to form bean-shaped spores were referred to genus Zygofabospora, according to Kudriavtsev's classification. These yeasts often develop as an admixture to the basic culture at the Saratovskii and Lobvinskii plants, but, as it is seen from the cited figures, have no production value notwith-

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standing their ability to assimilate both xylose and arabinose.

The production race of yeasts "Krasnoiarskaia no. 9" - Kr-9V, as well as yeasts CD-10a, which we uncovered in inoculators at the Saratovskii plant, surpass in degree of utilization of organic substances and in yield of mass the two other arabinose yeasts, and the production cultures L-2 and X-9. Yeasts X-6, which pertain [Begin p.12] also to genus Candida give a low yield of biomass with a high utilization of reducing substance. We explain this low activity in accumulation of biomass by yeasts X-6 by a peculiarity in their morphology: they develop in waste liquor in the form of long mycelial threads. It was noted that yeasts, which form during propagation in waste liquor long mycelioid cells or branched threads of pseudomycelium, form more scum, float in it and thus create worse conditions for propagation than yeasts which develop in a form of single gemmate cells or small branches. A microorganism, which was conditionally called T-3, and which occupies an intermediate position between the yeasts and the fungi, and, according to Zodder and Kreger von Riy's classification, comes the nearest to genus Trichosporon, accumulates biomass very actively and utilizes reducing substance and the organic acids of waste liquor more fully than the industrial yeasts L-2 and X-9.

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Table 1.

Genus and strain of yeasts	Utilized in %		Yield in % of reducing substance		Contents in yeast in %	
	Reducing substance from waste liquor	Organic acids	Absolutely dry yeasts	Normal absolutely dry yeasts	Protein	Ash
Candida L-2	65.2	26.0	41.9	37.5	44.4	9.2
Candida X-9	66.7	29.6	39.4	36.1	45.8	9.2
Candida Kr-9v	78.1	50.5	47.9	46.5	48.4	9.6
Candida SD-10a	75.4	67.5	67.9	60.4	44.4	6.9
Candida X-5	71.8	35.9	42.1	29.0	45.3	7.0
Zygofabospora SD-8	41.1	35.7	27.9	22.9	40.6	5.2
Zygofabospora L-1	52.5	27.5	23.8	18.6	39.5	8.9
Trichosporon T-3	73.9	40.8	51.6	48.5	47.0	7.2

Comparative evaluation of yeasts in waste liquor of Kanskii plant has shown thus, that the most prolific among the tested yeasts are Kr-9v, SD-10a and the fungus T-3.

Yeasts Kr-9v and SD-10a were also tested on waste liquor of Krasnoiarskii and Saratovskii plants. Yeasts SD-10a growing on Saratovskii plant's waste liquor were compared besides that with other yeasts isolated at the Saratovskii plant.

Results of tests are cited in table 2.

Table 2.

Genus and strain of yeasts	Utilized in %		Yield in % from the given reducing substance		Contents in Yeasts in %	
	Reducing substance from waste liquor	Organic acids	Absolutely dry yeasts	Normal Absolutely dry yeasts	Protein	Ash
Waste liquor from Krasnoiarsky plant						
Candida Kr-9v	75.0	56.1	53.9	57.1	52.8	10.7
Candida SD-10a	75.5	36.3	60.1	60.8	50.3	6.3
Waste liquor from Saratovskii plant						
Candida SD-10a	75.8	39.9	47.2	48.9	51.9	7.3
Candida SD-5	71.4	56.0	47.0	46.5	49.0	8.5
Torulopsis SD-1	74.1	37.6	43.6	35.6	38.9	8.7
Zygofabospora SD-8	39.8	8.1	12.0	7.7	40.4	5.9

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Yeasts Kr-9v and SD-10a growing on waste liquor from Krasnoiarskii plant also gave a high yield of mass and a large content of protein. Yeasts SD-10a growing on waste liquor from Saratovskii plant surpass in yields and degree of utilization of reducing substance other yeasts, which developed in inoculators of this plant as a basic culture, or as admixtures.

Yeasts Candida tropicalis SD-5, which were recommended to Saratovskii plant as one of the most active races of this species, also give a high yield when grown on waste liquor from this factory. Yeasts of genus Torulopsis SD-1, in spite of sufficiently full utilization of reducing substance from waste liquor, produced a yield of biomass considerably lower than yeasts of genus Candida.

Spore-bearing yeasts SD-8 proved to be the least fruitful.

Results of examination of the activity of propagation and accumulation of protein mass by individual strains of yeasts, which were isolated at Kanskii, Tavdinskii and Biriusinskii plants are cited in table 5.

Kanskii and Biuiusinskii plants work with yeasts Candida L-2. At the Kanskii plant a smooth race of these yeasts developed steadily, and was coded as L-2K. In inoculators at the Biriusinskii plant, where conditions for growing are subjected to changes, yeasts L-2 have formed several races, among which predominate a smooth race L-2B and a slightly crinkly race $L\text{-}2B_3$. The smooth race Candida tropicalis T-1 is the basic culture of Tavdinskii plant.

These races of yeasts were grown in parallel with arabinose yeasts Kr-9, SD-10 and K-5a on waste liquor which was prepared under laboratory conditions from hydrolysate from Kanskii plant. This waste liquor cannot be typical for Kanskii plant and for this reason the evaluation of yeasts has only a comparative significance.

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Table 3.

Genus and strain of yeasts	Utilized in %		Yield from the given reducing substance in %		Contents in yeasts in %	
	Reducing substance from waste liquor	Organic acids	Absolutely dry yeasts	Normal absolutely dry yeasts	Protein	Ash
Candida L-2K	72.0	28.6	47.9	39.6	41.4	6.6
Candida L-2B$_1$	83.7	45.8	44.8	35.2	39.4	5.8
Candida L-2B$_5$	82.6	45.8	49.7	45.1	41.5	5.9
Candida T-1	75.8	23.9	60.7	41.7	34.5	5.6
Candida Kr-9v	82.0	42.6	66.1	52.4	45.0	5.1
Candida SD-10a	80.0	54.6	57.9	62.9	54.5	6.1
Candida K-6a	79.6	39.4	58.6	49.1	45.7	5.1
Zygofabospora K-8	42.0	22.8	12.5	11.0	44.4	8.8
Torulopsis SD-9	45.5	46.6	28.4	26.7	46.7	6.2

Industrial races of yeasts L-2K, L-2B$_5$ and T-1, under laboratory conditions, during the periodic process of propagation in waste liquor of Kanskii plant gave a yield of absolutely dry mass about 40% of the initial reducing substance in waste liquor. Arabinose yeasts Kr-9v, SD-10a and K-6a under the same conditions guaranteed a yield of 50-60% from the reducing substance. Yeasts of genus Torulopsis, strain CD-9 and Zygofabospora, strain K-8, showed a very low degree of assimilation of reducing substances from waste liquor and a low yield.

On the basis of experiments, which were conducted with waste liquors from Kanskii, Krasnoiarskii and Saratovskii plants, it is possible to conclude that from among all the examined industrial races of yeasts the most fruitful, that is, able to provide the greatest yield of protein mass, are the yeasts of genus Candida, strains Kr-9v, SD-10a and K-6a. These new species of genus Candida, while having general generic features with Candida tropicalis SD-5 and L-2, differ from them in size and form of cells, in their ability to assimilate arabinose and a full absence of the ability to ferment sugar. Besides the property to assimilate arabinose, which is useful for the pro-

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duction, the yeasts Kr-9V, SD-10a and K-5a differ from other species of Candida in their high activity in propagation and in the capacity to accumulate mass with large contents of protein.

Microorganisms - admixtures, which were found in inoculators of the Yeast Growing Shops, for the most part proved to be low-yielding species of yeasts of genus Torulopsis or the spore-bearing yeasts of genus Zygofabospora. Among the constant companions of the industrial culture, the most prolific is the mycelial organism T-5, which also assimilates arabinose and has a high synthetic ability. This organism grows together with yeasts L-2 in inoculators of Lobvinskii plant helping in a more active accumulation of the biomass. [Begin p.13]

Conclusions

1. Among the tested industrial species and races of yeasts in hydrolytic mediums the most active, in accumulation of biomass and in utilization of reducing substance to a highest degree, are yeasts of the genus Candida Kr-9v, SD-10a and K-5a, as well as the fungus T-5, which are able to assimilate not only xylose, but also arabinose of the waste liquor. Under laboratory conditions these microorganisms give a yield of mass 10-15% higher than the other industrial races of yeasts of genus Candida.

2. Not all the industrial species of yeasts which are able to assimilate arabinose are characterized by high yields. Some of them, for instance yeasts of genus Zygofabospora L-1, SD-8 and K-8, as well as yeasts of genus Candida X-5, which propagate in waste liquor in the form of mycelium, give a very low yield.

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3. Yeast Shops in hydrolytic plants, which utilize the new technological scheme of continuous growing of yeasts, and which are working with less effective cultures must switch over to work with more prolific yeasts which assimilate not only xylose but also arabinose in waste liquor.

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Trans. A-862
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Grinshtein, I. M.

Uluchshenie kachestva syr'ia - vazhnyi rezerv uvelicheniia vyrabotki spirta.

[Improving the quality of raw material - an important means of increasing alcohol production].

Gidrolisnaia i Lesokhimicheskaia Promyshlennost', vol. 9. no. 6, pp.6-7. 1956. 301.8 G36

(In Russian)

Alcohol production at hydrolytic factories can be increased by two means: a) by higher efficiency of the equipment and b) by improved qualitative indexes.

The latter, unfortunately, is being utilized inadequately. In addition, in a number of cases, measures taken to increase the efficiency of equipment impair the qualitative indexes.

The technological indexes of hydrolytic factories are extremely unstable. Thus, the actual output of reducing substances [RV] from absolutely dry wood is low and fluctuates from 35 to 45%; the yield of reducing substances varies in different digesters - deviations from the average output usually amount to ± 15%. At some factories, alcohol concentration in brew [brazhka] at certain periods adheres persistently to the 1.5-1.65% level, while at other periods, as well as at other factories, it at best does not exceed 1.25-1.35%. These phenomena are caused by the drastic changes that take place in the quality of the processed raw material which is unstable not only in its chemical composition, but also in its granulo-metric one. The size of the chips is not uniform and there often is a considerable number of chips that greatly exceed the standard

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size established by the temporary Technical Specifications of 1953. Frequently, the chip dosage, too, fluctuates widely, and the composition of the mixture is not always sufficiently uniform.

The unstable composition of the raw material mixture makes changes in the loading of the hydrolytic apparatuses necessary. For instance, at the Saratov factory in which raw material is being weighed on scoop [kovshovye] scales, 5.5 to 5.6 tons of absolutely dry wood is being loaded onto a hydrolytic apparatus of a 37 m^3 capacity.

The extent of the influence exerted by the granulometric composition of raw material upon the qualitative indicators can be seen from data of the Arkhangelsk [Archangel] Hydrolytic Factory.

Lumber mills deliver chips and sawdust to this factory separately. They become intermixed in the process of unloading from railroad cars onto conveyers. Hydrolytic apparatuses are loaded from bins which have the same capacity as hydrolytic apparatuses. The bins are filled with raw material beforehand with the aid of two scraper conveyers. Usually the bins are not filled to capacity and the lacking amount of raw material is loaded directly from the conveyers.

The quantity of the chips and sawdust consumed is determined by the number of the unloaded railroad cars and is then converted into solid cubometers and into tons.

The curves on fig. 1 and 2 plotted according to average monthly computing data of the Arkhangelsk factory shows graphically that the sugar yield from a digester in a hydrolytic apparatus of a 50 m^3 capacity, and the concentration of alcohol in the brew change in relation to the composition of the processed raw material. The distinctly pronounced maximum on the curve of fig. 2 is determined by two factors acting in

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two opposite directions: by increased density of the load and decreased sugar yield with a high percentage of chip content.

The curve on fig. 3 serves as evidence that by increasing the chip content in the mixture, the load density of the hydrolytic apparatus shows at first a sharp increase reaching a maximum of 50-60%, and then slowly decreases.

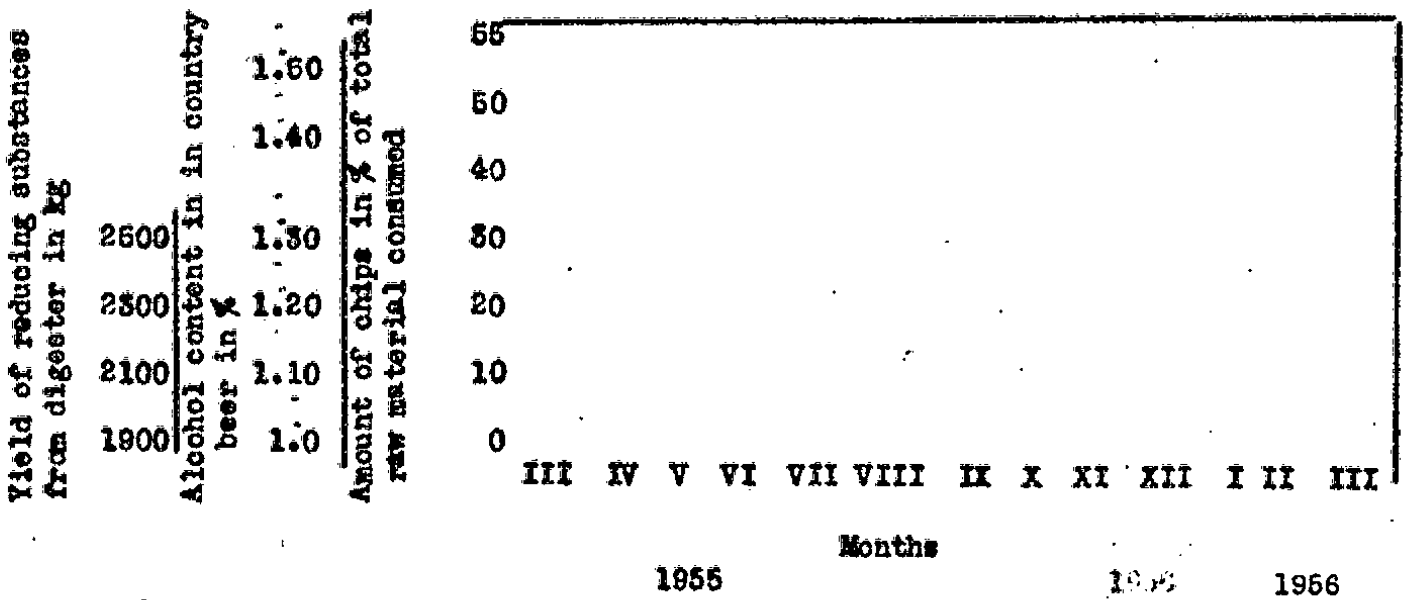

Fig. 1. Composition of raw material, yield of reducing substances from digester and concentration of alcohol in the brew according to average monthly data of the Arkhangelsk Factory:

1 - chip consumption; 2 - alcohol concentration in the brew;
3 - yield of reducing substances from digester

The amount of wood increases when the compactness of the load is increased, and, hence, the yield of the resulting sugar should also increase. The sugar yield, however, will not always increase in proportion with the increased amount of chips. If the content of the chips in the mixture will be higher than the fixed limit, then the yield will begin to decrease. This can be explained by the fact that the established regime of the digester, which is the optimum for the fixed composition of the mixture, proves

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disadventageous for mixtures with a high content of chips. An especially sharp decrease occurs in the sugar yield when the amount of the chips is considerable, yet the total weight of the loaded wood mixture has not increased.

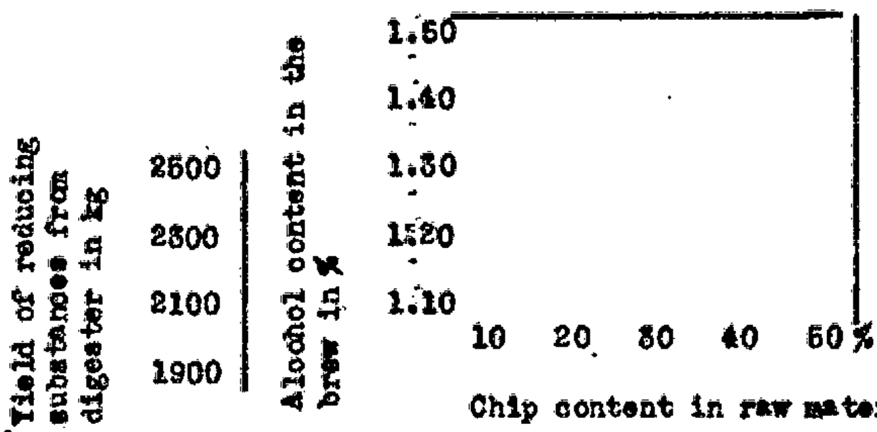

Fig. 2. Relation of qualitative indicators of hydrolytic production to chip content in raw mixture:
1- alcohol concentration in brew; 2 - yield of reducing substances from digester

Thus, one of the important factors in obtaining high yields of reducing substances and alcohol concentration in the brew is an optimal proportion of chips. Under conditions of the Arkhangelsk Facotry it amounted to 36-40%.

At this factory an experiment was conducted in conveying chips and sawdust into bins of hydrolytic apparatuses by means of two separate streams which became intermixed when the bins were unloaded. This method of conveying did not, however, justify itself, since it failed to produce a proportional raw material mixture in the hydrolytic apparatus. Frequently chips and sawdust were loaded into the apparatus in layers. In either case, however, the yield of reducing substances from the digester decreased immediately and alcohol concentration in the brew dropped.

The examples cited are sufficiently convincing that the qualitative

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indicators of the work done at hydrolytic factories could be considerably improved, if the raw material that is loaded into hydrolytic apparatuses were properly matched and its granulometric composition were stabilized. It is also extremely important to obtain chips of the required dimensions. At present, factories as a rule process very large chips and in a number of cases even a considerable amount of split pieces.

The compositional inconstancy of the raw material mixture decreases the effectiveness of the digester's technological regime.

It is impossible to obtain a stable sugar yield with a variable raw material composition and a constant digester regime. Yet it is very complicated to organize work with a variable regime that would change in relation to the composition of the raw material mixture. Hence, it is necessary to improve the work at raw material workshops of hydrolytic factories.

First of all the Technical Specifications for chips must be defined more precisely and special experiments must be conducted in order to establish a minimum size of chips that will permit to produce higher sugar yields. An optimal dosage of chips and an applicable technological digester regime must be selected for each individual factory.

Wood-cutting machines and sorting equipment must be installed in all lumber mills that supply hydrolytic establishments with raw material.

The organizational scheme for a wood cutting station should definitely provide for the separation of large pieces and for their crushing.

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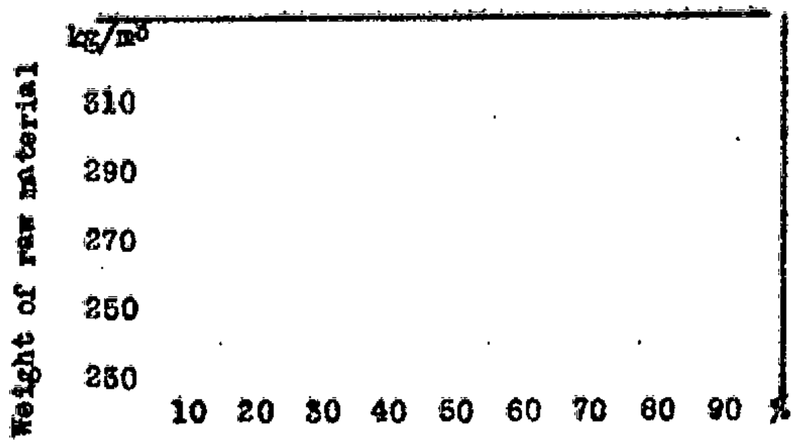

Fig. 5. Relation of load density to chip content in mixture.

Schemes for feeding raw material into hydrolytic apparatuses should be improved and an effort should be made to obtain a uniform chip and sawdust mixture.

Factory directors must check systematically whether the technical specifications concerning raw material are carried out.

From the editor. The data cited in the article by I. M. Grinshtein demonstrate once more the great importance of preparing raw material correctly in the improvement of qualitative indexes of the work done at hydrolytic factories. However, the Glavgidrolizprom [Main Administration of the Hydrolytic Industry], the Technical Administration of the Ministry, and directors of establishments do not pay due attention to the preparation of raw material - one of the most important units of the entire technological scheme of hydrolytic production. Repeated orders given by the leadership of the Ministry concerning this matter have not been carried out. New factories are put in operation with unfinished and partially equipped wood working [drevesnosyr'evye] shops. Having generalized the best experience of establishments, the Conference of Head Engineers of

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Hydrolytic Factories, held in April of 1955, determined upon more desirable schemes of refining raw material, but these schemes have not been carried out. Similar indifference to the preparation of raw material has in recent years lead to a decrease in sugar yield and in alcohol per unit of raw material, and to overexpenditures of hundreds of thousands of rubles.

The Technical Administration of the Ministry and the Management of Glavgidrolizprom should without delay take the measures necessary to organise at hydrolytic factories fully mechanised raw material workshops and a normal preparation of raw material that will insure qualitatively high production indicators.

VNIIGS [All-Union Scientific-Research Institute of the Hydrolytic and Sulfite Alcohol Industry]

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Bobovnikov, B. M., Tsirlin, Iu. A.,
Chepigo, S. V., and Shpuntova, M. E.

Poluchenie furfurola i etilovogo spirta pri kompleksnoi pererabotke khlopkovoi shelukhi.

[Furfural and ethyl alcohol production in complex processing of cottonseed husks].

Gidrolisnaia i Lesokhimicheskaia Promyshlennost' vol. 10, no. 2, pp.14-17. 1957. 301.8 G36

(In Russian).

CONCLUSIONS, p.16

1. The technological regime of two-phase hydrolysis of cottonseed husks and pentose dehydration which permit a production of 70 kg of furfural and no less than 70 liters of alcohol per ton of absolutely dry husks have been developed and tested under industrial conditions.

2. Compared with the proposed indices of the Andizhan factory, the new regime of pentose-hexose hydrolysis reduces operational time of the hydrolytic apparatus from 15 hrs 30 min. to 11 hrs 45 min. (by 15%), increases the yield of pentose sugar from 12% up to 19.4% (by 61%) and the yield of furfural from 4.15% up to 7% (by 69%), and reduces digester steam consumption to 17.2 tons which, considering the increase in the raw material load up to 8.3 tons, saves 12.2% of steam. Owing to the increase in raw material loading, the productivity of the hydrolytic apparatus has increased by 14.7%.

3. Utilization of the developed two-phase regime of pentose-hexose hydrolysis and of pentose dehydration will make it possible to increase the

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utilization of cottonseed husks up to 40-43% as against 10% when it was processed for furfural, or up to 20% when it was processed for alcohol (data of single-phase hydrolysis), and it will also increase the total technical and economic indices of furfural production.

4. A further improvement in the production of furfural and ethyl alcohol from complex processing of cottonseed husks should result in a decrease of steam consumption achieved by preliminary steaming of pentose hydrolysates with dehydration steam, in an increase in equipment efficiency (reduction of revolutions of the hydrolytic apparatus during stationary hydrolysis, continuous pentose hydrolysis and continuous pentose dehydration), and in an increase of the production output.

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*[Original citation of author's names is Lauren B. Hitchcock and Homer R. Duffey].

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Trans. A-864
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Barannik, A. D.

Snizhenie sebestoimosti kormovykh droshzhei na kanskom zavode.

[Decreasing the net cost of feed yeasts at the Kansk Factory].

Gidroliznaia i Lesokhimicheskaia Promyshlennost' vol. 10, no. 2, p.28, 1957. 301.8 G38

(In Russian)

In the year 1955 the yeast shop of the Kansk Hydrolytic Plant produced an average 80-90 tons of dry yeasts per month; the net cost per ton was very high and exceeded the sales price. The scheme used in the manufacture of the yeast deviated but slightly from the standard one recommended in 1952 by the yeast production laboratory of VNIIGS [All-Union Scientific-Research Institute of Hydrolysis and the Sulfite Alcohol Industry]. Its main deficiency was the complex preparation of the hydrolyzed spent waste used in growing yeasts that called for large expenditures and for much labor. Consumption of filter tissue and electric energy was great.

Owing to the unsatisfactory work of the filtration station the spent waste entered the inoculators unevenly and as a result, the yeasts failed to utilize fully the reducing substances [RV] and organic acids. Besides, the technological regime employed at the plant did not ensure complete hydrolysis of pentosans; the total amount of pentoses and organic acids found in the spent waste was comparatively low, and on such a medium the yeasts were unable to assimilate the reducing substances thoroughly. Under these conditions the yield of dry yeasts from the total amount of

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dry substances comprised 28-30%. The work at the shop was inefficient and unprofitable.

For the purpose of increasing the productivity of the shop and decreasing the net cost of yeasts, a series of measures designed to improve production technology and to remove "bottlenecks" were carried out. Purification of spent waste was simplified, communications were reduced, forced transfer of liquids was replaced by gravity flow, foam disposal spirals were installed in the inoculators for mechanical extinguishing of foam, and strict accounting was introduced for the consumption of electric energy, steam, chemicals and other materials. Simplification of the preparation of spent waste used to grow yeasts involved substituting filtration of spent waste with long sedimentation. This permitted to discontinue the use of expensive filter tissues, to release 10 workmen and to decrease sharply the consumtion of electricity. The productivity of inoculators has increased by 12-15% thanks to an even availability of yeast nutrition.

When oxidation of spent waste was abilished the exterior sedimentation tanks were used as head tanks and oxidizing agents as tail sedimentation tanks, which made it possible to eliminate from the technological scheme one BNTs-180 pump with an electric motor of 27 kilowatt capacity.

Installation of foam disposal spirals in inoculators has reduced the consumption of chemical foam extinguisher by 10-15 kg per ton of dry yeasts which also was reflected favorably in the net cost of production.

An important role in the increased production of yeast and in the reduction of the net cost was played by efficiency experts and inventors of the yeast shop. Thus, upon the suggestion of L. L. Ignatovskii, locksmith for separator repairs, yeast separators of the covered type released by the Bolshevskii factory have been improved. Having replaced in them the usual

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upper collectors with others taken from the DSG-4 separator, manufactured by the Shchelkovskii factory, with an additional device for the deflection of the brew [brazhka] thrown from the drum, it became possible almost to double the productivity of separators.

Preliminary washing of the spiral heat exchangers with hot water suggested by P. I. Man'kovskii, warehouse man and tool maker, decreased sharply the consumption of sodium hydroxide. Efficiency suggested by the shop electrician G. E. Bakas insured accident-free work of the reducers of disc inoculators and reduced standstills of fundamental equipment for repairs.

The VNIIGS brigade under the leadership of P. N. Fisher which worked at the facotry in September of 1955 assisted the shop considerably in setting up yeast production technology.

Advanced experience and creative activity of the yeast shop personnel brought the production of dry yeasts up to 112-120 tons per month within a comparatively short time and rendered yeast production profitable. The net cost per ton of dry yeasts was reduced by 13% against the planned cost.

	According to plan for 4th quarter 1956	Actually for October 1956
Raw material (Reducing substances in spent waste)	9.0	12.0
Ammonium sulfate	7.5	8.3
Superphosphate	4.0	4.0
Sulfuric acid	0.3	0.2
Foam extinguisher	14.4	13.4
Technological steam	7.0	6.6
Electric energy	16.8	14.1
Water	1.3	2.2
Wages	13.1	10.2
Divident for wages	0.9	0.6
Shop expenditures	16.2	21.8
General factory disbursements	7.5	4.3
Other expenditures	2.0	2.6
Total	100	100

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From the calculation of the net cost per ton of dry yeast cited above, it is apparent that the shop staff is capable of reducing even more the net cost of yeasts by decreasing shop expenditures and also the consumption of foam extinguishers and of steam.

Thus, the experience of the Kansk Factory has demonstrated that yeast production in the hydrolytic industry can and must become profitable.

Despite a number of difficulties the staff of the shop has fulfilled the 1956 production plan and has achieved a net cost of the manufactured yeast that was considerably lower than the sales price.

From the editor. Simplifying the technology of preparing spent waste by substituting the filtration of it with sedimentation is efficient, however, the elimination of oxidation of spent waste according to data of the yeast production laboratory of VNIIGS will impair the quality of yeast.

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More alcohol and fodder yeasts from non-food raw materials.

Gidrol. i Lesokhim. Promysh., vol. 8, no. 3. pp.1-3. 1955. 301.8 G36

(In Russian)

Communist Party and the Soviet Government direct the efforts of Soviet people to a further continuous raising of heavy industry. The National economy develops on the basis of powerful growth of the heavy industry, including the light and the food industry as well as large-scale socialistic agriculture.

The January Plenum of TsK of KPSS has set a problem - during the next five-six years to bring the annual total grain harvest to not less than 10 billion puds [one pud equals 36 pounds] and to increase the production of basic animal husbandry products by two or over two times.

The working class, the kolkhoz farmers and our intellectuals - all the Soviet people strive to solve successfully this most important problem in the shortest time possible.

Workers in hydrolytic and cellulose - paper industries are also called to contribute an important share to this great public work. Our duty is to utilize thoroughly and as fully as possible the large amount of sulfite alkalies and woodworking wastes for the production of ethyl alcohol, of fodder yeasts and of other products, and thus to permit the national economy to economize considerable amounts of grains and of natural fats, which are being utilized for technical purposes.

Production of ethyl alcohol from wood pulp by a method of hydrolysis and from sulfite alkalies has justified itself fully. Demands by different branches of animal husbandry for fodder protein yeasts are continuous

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ly growing. Development of these industries has big prospects under conditions of our country.

During the last four years of the fifth Five-Year Plan the efficiency of alcohol production at hydrolytic plants rose more than twice, and at sulfite-alcohol plants by 74%. During this time output of alcohol rose at hydrolytic factories by 2.3 times and at sulfite-alcohol plants by 97%.

Such tempoes of growth in efficiency and output of production by hydrolytic and sulfite-alcohol establishments still does not meet the growing requirements of the national economy in technical alcohol. That is why the Party and the Government, at the present time, set up the problem to ensure further development of hydrolytic and of sulfite-alcohol industries and of considerably higher tempos of growth of production and of raising the output.

By the end of 1960 the efficiency of production of ethyl alcohol from wood pulp wastes and from sulfite alkalies must be increased sharply.

For this purpose it is necessary to construct and bring into exploitation a series of new hydrolytic and sulfite-alcohol factories, as well as considerably to expand many active establishments.

It is especially important now to build quickly and expand the Yeast Shops in alcohol factories of the cellulose - paper combines, which will be able to put out products of high quality at the smallest production cost possible.

Workers in cellulose - paper industry must guarantee by the beginning of the year 1961 full conversion of alkalies to alcohol and fodder yeasts at all the active sulfite-cellulose establishments. At that time the output of sugar and alcohol per ton of cellulose must be sharply increased.

In projects for sulfite-alcohol plants it is necessary to provide for

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conversion of entire yeast wort to concentrates, and in projects for hydrolytic plants - conversion of all waste liquor to fodder yeast. The cost price of hydrolytic alcohol towards the end of 1960 must be lowered by not less than 30% compared to 1954.

The Ministry of Paper and Wood Processing Industries, must carry out measures for further improvement of technology of hydrolytic and sulfite-alcohol production, whereupon special attention must be given to working out and wide introduction of continuous processes, to radical improvement of technology for growing fodder yeasts and lowering of the cost price. Technological processes must be carefully checked and defined more accurately, taking into consideration all the achievements of modern science and technique.

In 1955 large works have to be carried out in construction of hydrolytic and sulfite-alcohol plants.

Next year the extent of capital construction must rise sharply.

[Begin p.2]

In order to carry out successfully a program for further development of hydrolytic and sulfite-alcohol industries it is necessary determinedly to find and correct all shortcomings in the leadership of the establishments, of building organizations, scientific-research and planning institutes; to direct the efforts of all workers, of engineering-technical workers and employees to full utilization of the existing reserves, to introduce widely into all branches of production the newest attainments of science and of leading technique; to strengthen the labor and state discipline.

The foremost duty of industrial workers is to ensure unconditional fulfillment of the production plan and of fundamental construction by all

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the establishments and organizations. A Government plan is the law for every factory and for every construction, and this plan must be strictly observed. That is why one should not tolerate the fact that many alcohol plants and construction - assembly administrations systematically do not fulfill the plan. For instance, during four months in 1955, the plan for the output of alcohol was not met by six hydrolytic plants of Glavgidrolizprom [Chief Administration of Hydrolytic Industry] and by eight alcohol factories of Glavtselliuloza [Main Administration of the Cellulose Industry]. Such a situation should be inadmissible in the future.

Production of alcohol, yeasts and other products should not be increased only by construction of new factories, new workshops and by supplementing the equipment. The Party and the Government require from industrial workers that they utilize better the existing production areas and the available equipment. It is necessary to obtain more production from each unit of equipment, to put out more goods per each worker. Hydrolytic and sulfite-alcohol industries have here great possibilities. Nevertheless, one should mention here that the inner reserves for increasing the productive capacity of labor, for raising the production output and lowering the cost are yet put in action badly.

The collective body of Biriusinskii Hydrolytic plant obtained on the average, in 1954, from each cubic meter of hydrolytic apparatus capacity 94.6 liters of alcohol per 24-hour day. Only the Krasnoiarskii plant came nearest to this indicator. Lobvinskii and Tavdinskii factories utilized the hydrolytic apparatus much worse. Workers at Stalingradskii, Saratovskii and Segezhskii hydrolytic plants obtained daily 40-50 liters of alcohol less than the Biriusinskii plant from a unit of capacity of similar apparatus.

Lobvinskii and Tavdinskii hydrolytic plants are situated in the same

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oblast' and have identical technological equipment. Yet the cost of each ton of fodder protein yeast at Tavdinskii factory is three times higher than at the Lobvinskii.

Workers at the Kamskii Combine obtain about 250 kg sugar per ton of cooked cellulose and, on the average, 80 liters of alcohol. The Combine can raise considerably the output of alcohol if they will introduce the multi-stage washing of cellulose and put into effect certain other measures. Nevertheless, many cellulose - paper combines have yet a very low output of alcohol, and a large amount of sugar, contained in the alkali, remains unutilized. Thus, the workers of Sukhonskii and Sokol'skii combines obtain only 37-45 liters of alcohol per ton of cellulose.

These and many other facts show that if the supervisors of Glavgidrolisprom,* of Glavtsellulosa,** of Glavvostbumprom [Main Administration of the Cellulose and Paper Industries of the Eastern Region], of Glavsakhalinbumprom [Main Administration of Sakhalin Paper Industries] would have studied the experience of leading plants in a business-like manner and would introduce it to the other establishments, then national economy could be supplemented with hundreds of thousands of decaliters of alcohol, many tens of tons of fodder yeasts and the cost of production could be lowered.

Supervisors, engineering-technical workers and workers in cellulose - paper combines must strive for full utilization of each cubic meter of wood balance. It is inadmissible that a considerable part of this valuable raw material be wasted, which was prepared and delivered to the establishments as a result of tense work of many Soviet people. It is necessary to in-

*[Chief Administration of Hydrolytic Industry].
**[Main Administration of the Cellulose Industry].

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troduce progressive methods for selection of alkalies on all the sulfite-cellulose plants, to organize socialistic competition among digester workers for the highest yield of sugar per each ton of cellulose.

It is known that every chemical and biochemical industry requires irreproachably accurate, rythmical work of all shops in the establishments. Yet many hydrolytic and sulfite-alcohol plants do not have that yet. Interruptions in work and unplanned stoppages of individual sections disrupt the production, worsen the utilization of technical equipment, lower the productive capacity of workers, increase the cost. production. One cannot tolerate any more the serious deficiencies which are found in the organization of alcohol and yeast production.

Problems which rise before the industry require that our scientific-research and planning institutes solve faster these arisen problems in the improvement of technical equipment and of production technology. Industry needs new highly productive and economical apparatus and technological methods, which are based on modern attainments of science and technique.

Scientific workers, designers and constructors must develop continuous speed methods for hydrolysis of plant tissues, for reprocessing of sulfite alkalies; develop more improved methods for the production of fodder yeasts, as well as design equipment which will incorporate the latest attainments of native and foreign technique.

One of the most important problems for VNIIGS is to widen the scientific-research and experimental works for further improvements in the process of pulp wood hydrolysis, which will decrease the amount of water needed for the process and increase the technical-economical indicators of work of the establishments.

Introduction of newest attainments of the leading technique and technology will permit us to increase considerably the output of products at the

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acting establishments; to build faster and with smaller expenditure of money new hydrolytic and sulfite-alcohol factories.

Workers from the Designing Institute of Giprogidroliz [State Institute for the Planning of Hydrolytic Plants] have of late made several good plans for separate workshops, units and for new kinds of equipment. But there still are some defects in the activity of the Institute, which hold back the development of hydrolytic and sulfite-alcohol industries. The collective body of Giprogidroliz together with VNIIGS workers bears the responsibility for unsatisfactory conditions of the technique in yeast production. Yeast workshops, up to the present time, were designed without taking into consideration the new technique and without analyzing the economic indicators. Designers do not properly study and utilize the newest attainments of science and technique, and in certain improtant questions just mark time.

Industry has a right to expect that collective bodies of scientific-research and designing institutes, which have among their ranks a large number of specialists of high qualifications, will exert every effort in order to overcome in a short time all defects in their work and raise it to a higher level which will answer the modern requirements. [Begin p.3].

Technical Administration and the Administration of Capital Construction of the Ministry, in view of new decisions, must thoroughly revise the work of institutes, must define their thematic plans more exactly, as well as their working programs and assignments. The Personnel of the institutes must be supplemented with qualified designer - constructors, and all their efforts must be directed for developing new kinds of apparatus and devices which are extremely needed by the industry.

Successful solving of new problems, which arise before the hydrolytic and sulfite-alcohol industries, will be helped greatly if specialists who

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work in the establishments take active participation in scientific research. It is necessary to organize a truly creative concord between scientific and production workers. Technical Administration of the Ministry, Glavgidrolizprom, Glavvostbumprom, Glavtselliuloza, Glavzapbumprom [Main Administration of the Cellulose and Paper Industries of the Western Region], and Glavsakhalinbumprom, as well as the supervisors of establishments must encourage greatly the work of inventors and innovators; to organize competitions for development of most perfect specimens in equipment and of methods in technology of production of alcohol and of yeasts; to give all possible skilled help to the innovators.

Duty of designers constructors is to fulfill exactly on time their assignments of introducing new efficient methods for each hydrolytic and sulfite-alcohol plant. Glavbumdrevstroi [Chief Construction Administration of Paper and Lumber Industry] and the chief industrial administrations must furnish qualified personnel to the existing construction - assembly administrations as well as to divisions of capital construction of combines and factories, to widen their own construction base, determinedly to improve the organization of work on the building lots, to widely introduce mechanization and progressive methods in construction.

It is necessary, in Siberia, to finish quickly the organization the of combine of Gidrolizpromstroi [Chief Construction Administration of Hydrolytic Plants], and staff it with qualified cadres from Construction-Assembly Administration of the Moscow Combine; it has in prospect large construction works in the southern part. Large sums of money were earmarked for construction which should be self-supporting. Directors of the existing establishments must pay more attention to capital construction. Administration of Capital Construction of the Ministry and Divisions of Capital Con-

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struction of the Chief Administration are obliged to inspect daily the progress of these works at the combines or plants.

An urgent problem in the field of construction is decisevely to improve its planning and organization of material-technical supplying; to take all measures so that the program of construction and expansion of hydrolytic and sulfite-alcohol plants be fully accomplished from month to month.

In scientific-research and in designing institutes, in chief administrations of the Ministry, at the establishments and on construction projects, it is extremely important to develop criticism of defects, based on principle directing its point at all those who retard all that which is new, who prevent the creation and introduction of the leading technique, or who are indifferent to this important job; at those who are ready to sacrifice the fundamental interests of the industry to their placidity, complacency and inertia.

In order to uplift the level of organization of production and of capital construction, to further both technique and technology, to lift the productive ability of labor, to lower the cost price of production and the cost of construction, people are needed who know the work and are able to cope with problems which were put before them. Thus, correct choice, placement, education and raising of the technical level of the cadres becomes of deciding importance. It is necessary to plan carefully for each establishment a system of studies for further increase of qualifications of engineers, technicians and workers for the preparation of cadres for new plants; to create favorable conditions for fruitful studies of students of correspondence course, for work in evening schools and schools for leading experience.

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Success in the work on all sections greatly depends now on skillful and operative leadership. Role and responsibility of workers of the Ministry, of chief administrations, supervisors of concerns, of construction, shops, sections, as well as of all commanders in industry increases immeasurably. To be a leader in our time is to observe in good time, to study deeply, actively to support and widely to spread all that is valuable and new, to fight consistently backwardness and neglect, to show initiative, boldly to put and solve new problems to work tirelessly with people, organizing and mobilizing them for transforming into life the decisions and directives of the Party and of the Government.

Economy in grains and in natural fats, which are used for technical purposes, is of the greatest national importance. That is why selfless labor of workers of hydrolytic and cellulose-paper industries, which is directed for a quick further development of production of alcohol, fodder yeast and of other products from nonfood raw materials is a valuable contribution to the building of the Communist society.

Developing, ever wider, socialistic competitions for completion of the industrial plan prematurely, as well as the plan for capital construction of 1955, which is the concluding year of the fifth Five-Year Plan, the workers, engineers, technicians and employes of hydrolytic, cellulose - paper combines and construction-assembly administrations are perfectly resolved to fulfill with honor the honorable new assignment of the native land.

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Broido, N. F., Vanshenker, R. Ia., and Dolbnin, A. V.

Ob avtomatizatsii deistvyiushchikh gidrolisnykh
i sulfitno-spirtovykh zavodov*

[Automation of hydrolytic and sulfite-alcohol factories now in operation]*

Gidrol. i Lesokhim. Promysh. no. 2,
pp.3-6, 1956. 301.8 G36

(In Russian)

[p.1, par. 1]. Automation of hydrolytic and sulfite-alcohol production will make it possible to normalize the technological process of production, to standardize the quality of the products being released, and at the same time to increase sharply the efficiency of factories and to decrease the net cost of production.

This article does not deal with a working project of the automation of any concrete object. The objective of the authors of this article is to share some considerations and suggestions designed to find technical solutions that would enable the joint efforts of manufacturers, planners and researchers in the near future to use automation in the hydrolytic and sulfite-alcohol factories now in operation.

FERMENTING DEPARTMENT AND YEAST SHOP [p.5, par. 4].

Automation of fermenting departments and yeast shops that use filters and separators involves difficulties. It is necessary first of all to

* In the order of a discussion.

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find more improved technological equipment the possibility of which Giprogidrolis [State Institute for the Planning of Hydrolytic Plants] is exploring at the present time.

Up to now the evolving gases, the amount of which serves as an indicator of the intensity of the process, have not been utilized in fermentation control. The standard gass analyzer is adequate to determine the CO_2 content in percentages. Since the fermenting tanks have a great capacity and the fermenting process is very inert, it is possible to get along with solely the indicative and registering gas analyzer according to which the dispatcher can rectify the process. It is, however, necessary to render the fermenting tanks air-tight in order to determine the amount of CO_2.

To determine the level in the brewing tanks, methods based on nuclear radiation can be used with some success. The scheme of an apparatus with radioactive isotopes is in the given case analogous to one already described.

SULFITE-ALCOHOL FACTORY [p.6, par. 7].

Methods of automation which have been examined and which are used in the processes of a number of departments of the hydrolytic factory can be applied to a certain extent to sulfite-alcohol factories as well. In addition there arises the necessity of preparing the alkali more effectively, of determining and regulating the degree of purification of the solution within the alkali and yeast sedimentation unit, of regulating the processes of vacuum evaporation of alkali in the production of solid castings, and of mechanization and automation of the packing of spent waste concentrations into containers before transferring them to the warehouse.

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The automation scheme of the department for the preparation of fermentation alkali becomes cumbersome as a result of the periodic character of the work done by this system and because it makes the use of complex regulators necessary. The standard schemes of the alkali process must be radically changed and an effort must be made to find more efficient schemes for apparatuses that will permit the introduction of alkali preparation by continuous flow.

The scheme of continuous blowing of sulfite alkali in a thin layer within a columnar apparatus with cutting steam may serve as an example. Testing carried out by VNIIGS [All-Union Scinetific-Research of Hydrolysis and the Sulfite Alcohol Industry] at the Priozerskii Factory has shown that alkali with reduced acidity can be obtained in such a columnar apparatus. This permits eliminating from the technological process the neutralization of alkali by means of milk of lime and the sedimentation of alkali from the precipitating gypsum. [Begin p.6]. Adoption of such a scheme by industry would simplify considerably the preparation of alkali for fermenting and the automation of this unit [uzel], inasmuch as the regulation of the process would fundamentally amount to a regulation of steam consumption by available and simple means. Such an innovation, however, would make it necessary to arrange the whole unit for the preparation of alkali at a cellulose plant in the immediate proximity of digesters, since, in the given case, SO_2 contained in the alkali can again be returned to production, while it is irrevocably lost when the alkali is exposed to blowing by air. VNIIGS and TsNIIB [Central Scientific Research Institute of the Paper Industry] must jointly arrive at a final conclusion as to the adequacy of this scheme and they must establish the necessary parameters.

The realism of this problem is so much the more obvious because the

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equipment of the Neutralizing Department accepted for standard schemes is inadequate for automation. Concomitantly with the search for original designs of pH-meters with self-purifying electrodes, special neutralizers must be developed with dosage installations for milk of lime and nutritive salts that satisfy the demands of automation production.

The standard schemes for sulfite-alcohol production provide for fermenting of alkalis in tanks with a floating nozzle, and in the yeast shops - for yeast separation by centrifual separators which are complicated and some of which have to be stopped periodically and taken apart so the individual parts can be cleaned. This hinders the establishment of any efficient scheme of atuomation of the process.

A more progressive scheme must be worked out for the isolation of alcohol producing yeasts and also for technological processes of growing, drying and packing of feed yeasts by utilizing the latest methods and apparatuses which, along with the increase in the transmissible capacity [propuskmaia sposobnost'] of the department, will insure the continuous work of the system and its full automation with remote control from the control board.

"Giprogidroliz" has developed the fundamental principles for complex automation of sulfite-alcohol factories on the basis of standard controlling and regulating equipment. These principles have been approved by the Technical Council of "Giprogidroliz".

CENTRALIZATION OF MANAGEMENT

Automation of production will require centralization of all basic units of hydrolytic and sulfite-alcohol factories. With this objective it is necessary to create a dispatching center from which the dispatcher

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could observe, control and direct the technological process. The control boards must be equipped with control units and regulators, keys for the operation of electric drives, regulating and shutting off valves and bolts, as well as other switchgear and signaling equipment. The dispatching center must also have a mnemonic technological factory of the scheme with contour graphing of the units. The large dimensions of the apparatuses and their considerable quantity render the dispatching switchboards too cumbersome. As a result, there arose the acute problem of creating control apparatuses and regulators of small dimensions. Domestic industry has begun to develop such apparatuses.

In certain cases, in order to simplify servicing, such automation boards will be essential in every department.

TRAINING OF STAFFS

Training of qualified workers for the servicing of controlling and measuring apparatuses and for the automation of the hydrolytic and sulfite-alcohol industry is assuming great importance. This problem must be resolved without delay. Work within the domain of automation calls for special knowledte which a segment of our factory personnel lacks at the present time.

The automation training program at the Institute for Raising the Qualifications of Engineering and Technical Workers of the Ministry of the Wood Pulp and Wood Processing Industry, USSR (Leningrad), in which workers of the Hydrolytic Industry are trained, is inadequate for today's and particularly for tomorrow's problems.

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CONCLUSIONS

The quickest possible introduction of automation in ~~the~~ hydrolytic and sulfite-alcohol production requires the following:

1. Providing all operating hydrolytic and sulfite-alcohol factories with standard controlling and regulating equipment in a volume specified in the plants; this will make it possible to raise the technical level of production, to accumulate experience in automation and to prepare staffs for the more complicated systems of self-regulation.

2. Organizing at the Ministry of Wood Pulp and Wood Processing Industry of the USSR a single scientific-research automation laboratory, since the existing laboratories of VNIIGS, TsNIIB and other institutes are incapable of solving automation problems based on the latest scientific and technical achievements without the proper equipment.

3. Developing with the aid of specialized organizations the latest data units [datchik] for continuous determination of reducing substances, pH and some other parameters of the hydrolytic and sulfite-alcohol production, and adapting these apparatuses to industry in the near future.

4. Organizing at the Technological Institute imeni V. M. Molotov a group of instructors for the training of specialists in the automation of the hydrolytic, sulfite-alcohol and wood pulp chemical production.

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Nemtsova, N. P., and Aliamovskaia, T. S.

Kormovye drozhzhi iz podsolnechnoi luzgi.

[Feed yeasts from sunflower husks].

Gidrol. i Lesokhim. Promysh. no. 3,
pp.16-17. 1955. 301.8 G36

(In Russian)

Sunflower [seed] husks, rich in pentosan, are a valuable raw material for the production of feed yeasts. In previous years the VNIIGS [All-Union Scientific-Research Institute of Hydrolysis and the Sulfite-Alcohol Industry] Laboratory for Yeast Production established that in growing feed yeasts on pentose hydrolysates of sunflower husks (without refining the raw material before the hydrolytic process) the yield of absolutely dry yeasts contained 8% of nitrogen and comprised 44 kg per ton of absolutely dry raw material. Refining the husks prior to hydrolysis with water and an acid extract reduced the vigor [effektivnost'] of yeast growth in a pentose hydrolysate. In this case the yield of absolutely dry yeasts per ton amounted to merely 14 kg.

Growing yeasts on a mixture of pentose hydrolysate with a water extract obtained in refining husks increased the yield of absolutely dry yeasts up to 55 kg per ton of raw material. This can be explained by the fact that pentose hydrolysate depleted in the process of refining with salts and substances stimulating yeast growth, is again enriched by them when it becomes intermixed with the water extract. Supplementary experiments were conducted in connection with the planning of a hydrolytic factory designed for the processing of sunflower husks in which the utilization of the pentose

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portion of the hydrolysate was specified for the production of feed yeasts. The feed yeasts were grown under laboratory conditions on hydrolysates obtained in experimental digestion of sunflower husks at the Fergana Hydrolytic Factory under a regime developed by VNIIGS in 1953.

Table 1 cites the chemical characteristics of substrates obtained in hydrolysis of sunflower husks.

An analysis has shown that reducing substances in a pentose hydrolysate contain scarcely any polymers; a supplementary inversion of this substrate practically failed to increase the concentration of the reducing substances. The high content of pentoses and organic acids made it profitable to use this hydrolysate to grow yeast.

GROWING YEAST ON A PENTOSE HYDROLYSATE

The yeast used in experiments was Candida tropicalis SD-Ss employed successfully for several years at the yeast shop of the Saratov Hydrolytic factory.

Table 1.

Name of indicators	Pentose hydrolysate	Hexose hydrolysate
Reducing substances [RV] in %	2.83	1.95
Reducing substances after removal of non-carbohydrates in %	2.83	1.95
Reducing substances after inversion in %	2.90	1.97
Pentoses in %	2.56	0.43
Organic acids in %	1.05	0.52
Fermenting sugar in %	0.39	1.63
Fermenting sugar in relation to general reducing substances in %	13.8	79.54
Phosphorus (P_2O_5) in mg/liter	80	47
Nitrogen, general in mg/liter	476	168
Nitrogen, mineral, in mg/liter	70	14
Dry substances in %	5.8	3.6
Ash substances in %	0.43	0.24
Alcohol content after alcohol fermentation in % by volume	0.20	0.70

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[Begin p.17]. Pentose hydrolysate (obtained without previous refining of the raw material) was prepared by neutralizing it at a temperature of 80-85° [C] with milk of lime up to pH=4.8-5.0 and by enriching it with nitrogen which was added in the form of ammonium sulfate. Then the neutralizate was filtered. Yeasts were grown by a periodic method. The superphosphate extract was added directly to [the ingredients] in the tank so as to grow yeasts while accumulating a yeast mass.

To clarify how a concentration of reducing substances influences an active propagation of yeasts, the hydrolysate was diluted with water up to an average concentration of reducing substances, 1.07, 1.66 and 2.28%. The experiments have demonstrated that within the limits of these concentrations the yeasts SD-8s assimilate sugar similarly. The yield of absolutely dry yeasts with an 8% nitrogen content comprised 50-54% of the reducing substances. According to all indicators the yeasts complied with the technical specification [TU] 148-52 and surpassed them with respect to color and taste.

GROWING YEASTS ON THE SPENT WASTE OF A HYDROLYSATE OF A SINGLE-PHASE DIGESTER OF SUNFLOWER HUSKS

Pentose and hexose hydrolysates were received separately from the Fergana Factory. In order to detect the indicators of yeast growing on the spent waste of a hydrolysate of a single-phase digester of sunflower husks, we mixed pentose and hexose hydrolysates in exact conformity with the distribution hydro-module of each hydrolysate. Henceforth we shall call it the hydrolysate of a single-phase digestion.

When the mixture contained 1.99% of general reducing substances, the amount of fermenting sugar reached 55.5% of the total reducing substances, which insured an approximate 1% concentration of reducing substances in

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the spent waste. Such a concentration is more favorable for the growth of yeasts.

After the fermentation of hexose by the yeasts Saccharomyces cerevisiae and the distilling of alcohol, the spent waste of the hydrolysate of a single-phase digestion had pH=4.5-4.6 which fully satisfied the demands made of the substrate designated for yeast growing. The preparation of spent waste amounted merely to an addition of ammonium sulfate. The super-phosphate extract was added while the yeast was in the process of growing. The SD-5s yeast obtained was of good quality. The yield reached 54.8% of the reducing substances.

The experimental results are cited in table 2.

Table 2.

Substrate	Method of growing	Assimilated by yeast in %		Absolutely dry yeasts in %		Yeast yield		
						Absolutely dry in % of reducing substances	Normal absolutely dry*	
		Reducing substances	Organic acid	Protein	Ash		In % of reducing substances	In gm/liter
Spent waste of hydrolysate of singlephase digester	Periodic	80.8	71.9	50.6	6.3	52.2	54.8	4.5
Mixture of pentose hydrolysate and spent waste of hexose hydrolysate	same	82.8	57.0	46.0	7.1	45.9	43.5	5.0
Same	Continuous	80.2	52.4	46.8	6.2	49.5	46.7	5.4

*Normal absolutely dry yeasts contain 50% of protein.

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GROWING YEASTS ON A MIXTURE OF PENTOSE HYDROLYSATE AND SPENT WASTE OF HEXOSE HYDROLYSATE

In growing yeasts separately on pentose hydrolysates and on the spent waste of hydrolysates of a single-phase digester, the yeast mass accumulated adequately and the yield of absolutely dry yeasts comprised 14-14.7 and 4.5 g/l respectively.

There arose the question as to the desirability of growing yeasts on a mixture of pentose hydrolysate and spent waste of alcohol. This would save steam in alcohol production because a smaller volume of liquid would have to be heated in distilling alcohol only from the brew of a hexose hydrolysate.

Prior to the preparation of the mixture, the pentose hydrolysate was neutralized by milk of lime and by adding ammonium sulfate; ammonium sulfate was added also to the spent waste of the hexose hydrolysate.

The yeast grown on this mixture assimilated adequately the reducing substances (see table 2); the yeast yield increased when grown by the continuous method.

GROWING OF DIFFERENT YEAST SPECIES

Apart from Candida tropicalis SD-5a yeasts, on substrates obtained in hydrolysis of sunflower husks were grown Candida sp. Kr-9v yeasts which are utilized in the yeast shop of the Krasnoiarsk Hydrolytic Factory (table 3).

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Table 3.

Substrate	Yeast species	Assimilated in %		Content in absolutely dry yeasts in %		Yield of yeast			Yeast yield per ton of absolutely dry h… in kg	
		Reduc. subst.	Organic acids	Protein	ashes	absolutely dry yeasts in % of reduc. subst.	Normal absolutely dry yeast in % of red. sub.	Normal absolutely dry yeast In g/l	Absolutely dry	Normal a… solutely dry
…ntose hydrolysate	SD-5s	80.6	68.7	48.8	6.6	51.5	54.4	14.7	65.9	67.8
…me---------------	Kr-9v	88.0	55.7	50.0	-	50.1	53.7	14.5	63.1	66.7
…ent waste of hy…rolysate of single…hase digester	SD-5s	80.0	44.8	51.9	6.4	55.1	59.06	4.7	66.0	70.5
…me ---------------	Kr-9v	83.4	49.0	49.4	6.8	57.4	57.0	4.8	73.2	72.6
…xture gof pentose …ydrolysate and …pent waste of …exose hydroly…ate	SD-5s	82.8	37.0	45.0	7.1	45.9	43.5	5.0	79.8	75.6
…me -------------	Kr-9v	86.5	51.1	49.0	6.5	56.8	55.7	6.2	94.5	92.7

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Table 3 indicates that SD-5s as well as Kr-9v yeasts from the Candida species thrive on all hydrolysates of sunflower husks. On a pentose hydrolysate both cultures produced practically the same yield at the rate of 14.5-14.7 g/l of substrate, which corresponds with 67.6 and 66.7 kg of dry yeast per ton of absolutely dry husks.

On a hydrolysate of a single-phase digester the yield of dry yeast per unit of raw material amounted to 70.5-72.6 kg.

Growing of yeasts on a pentose hydrolysate and a spent waste hydrolysate mixture has demonstrated the superiority of Kr-9v yeast over the SD-5s yeast; the yield of the first amounted to 92.7 kg/ton and of the latter to 75.6 kg/ton.

These experiments have demonstrated that the SD-5s Candida tropicalis yeast and the Kr-9v Candida sp. yeast which are utilized in yeast shops of hydrolytic factories can be grown with some success on the hydrolysates of sunflower husks.

CONCLUSIONS

1. Substrates obtained in the hydrolysis of sunflower husks are a valuable raw material in the production of feed yeasts.

2. The most effective results are obtained in growing yeasts on a mixture of pentose hydrolysate and spent waste of hexose hydrolysate.

3. Yeasts grown on various substrates obtained in hydrolysis of sunflower husks meet the Technical Specifications 143-52 for feed yeasts.

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For further technical progress in the production of feed yeasts.

Gidrol. i Lesokhim. Promysh., no. 6, p.8. 1955. 301.8 G36

(In Russian)

A 868

A radical improvement in the production of feed yeasts is the pressing task of engineers, technicians, laborers and employees of the hydrolytic and sulfite-alcohol industry.

The low yield of yeasts per unit of raw material, the excessive consumption of electric energy and auxiliary materials, and the high rate of shop and over-all factory expenditures raise the net cost of yeasts at many factories considerably higher than their sales price. All of this is the result of faulty techniques and faulty technology of yeast production.

Up to now, yeast shops of hydrolytic and sulfite-alcohol factories have been using unproductive and obsolete equipment - separators, yeast growing apparatusues etc. An improtant technological defect is primarily its being designed for the processing of initial raw material such as spent waste with a low concentration of sugar.

Many years of experience in biochemical production - of beer, wine and alcohol from food raw material and molasses, baking yeasts and antibiotics - have confirmed the expediency of using only solutions with a concentration of nutritive substances. Taking into consideration the advanced experience abroad (particularly the experience of the Hungarian People's Republic), establishments releasing baking yeasts made from molasses are now adopting the processing of initial spent waste with a 3.5-4% concentration of sugar, i.e. twice as much as was used earlier. The yeast shops of hydrolytic and

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sulfite alcohol factories should also be converted for yeast growing in concentrated substances.

The need of rejecting the obsolete method of growing yeasts in foam which involves an unproductive consumption of expensive fatty substances for foam extinguishing and, most important, hinders the development of highly intensive technological processes required for yeast growing, has long since been ripe. Yeast shops which are inadequately equipped with controlling and measuring apparatuses and the complete aabsence of automatic regulation of processes retard technological improvement in the yeast industry.

Serious omissions in the organisation of production which occur at many establishments lead to incomplete utilization of capacities and great losses of sugar and semifinished products. As a result of the losses, it has been impossible up to now to increase the yeast yield obtained from initial sugar over 70-75% of the practicably possible level.

All of these shortcomings occurred because the importance of yeast production for the national economy was underestimated by the workers of Glavgidrolizprom [Main Administration of the Hydrolytic Industry], Glavtselliulozy [Main Administration of The Cellulose Industry], Glavvostbumprom [Main Administration of the Cellulose and Paper Industries of the Eastern Regions], the Technical Administration of the Ministry, and by the leaders of a number of establishments.

Only this can explain the reason why the testing of various types of equipment, such as inoculators, evaporators for the concentration of yeast plasmolysis, vacuum-filters for yeast separation, and others has been dragging along since 1948. In the past seven years some of these types of equipment have become obsolete and have been replaced abroad by the latest techniques.

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The same minimizing attitude must be held responsible for the inadequate volume of scientific-research work and designing done in the realm of yeast production within VNIIGS [All-Union Scientific-Research Institute of Hydrolysis and the Sulfite-Alcohol Industry] and Giprogidroliz [State Institute for the planning of Hydrolytic Plants], as well as at the institutes of other Ministries and Departments.

The directors of the Glavkov [Main Committee for Governmental Departments (?)] and establishments, engineers, technicians and laborers of yeast shops are faced with the problem of implementing within the shortest possible time measures for production improvement that were specified at the Conference of the Heads of Yeast Shops held in March of 1956 and at the Conference of the Leading Workers of the Hydrolytic and Sulfite-Alcohol Industry held in May of 1955.

To fulfil the resolution of the Party and the Government concerning a sharp increase in the output of feed yeasts by 1960, it is necessary, first of all, to increase decisively the utilization of the planned capacities of yeast shops. To accomplish this it will be necessary to equip fully the yeast shops now in operation with all essential apparatuses and machines, to bring their technological schemes into conformity with the plans and to eliminate the "bottlenecks" which have manifested themselves in the exploitation process.

In 1956 it will be necessary to carry out an extensive program for the testing of new types of equipment, particularly of the Clare-separator [klerseparator], ribbon vacuum filter, water-jet pump, evaporators, inoculators with air distribution of the "Segner wheel [segnerovo koleso]" type. The new scheme for the preparation of substrates for yeast growing must be checked and the amount and types of nutritive salts must be defined more

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precisely. The expanded yeast growing plan of VNIIGS includes industrial tests of new technological regimes at the Lobvinsk, Krasnoiarsk, Kansk, and Biriusinsk hydrolytic factories, as well as at the Priozersk and Vyborg sulfite-alcohol factories.

In the current year [of 1955] the VNIIGS yeast laboratory must under commercial conditions check and adopt an efficient regime of continuous yeast growing and also a technological scheme and regime for the production of feed yeasts from other types of raw material, it must make suggestions for an effective substitution of fatty foam extinguisher with mechanical foam extinguishing.

Manufacturers and scientific workers must concentrate their efforts on expanding the valuable beginnings of leading establishments. All factories should, for instance, catch up, as soon as possible, with the experience of the Priozersk and Lobvinsk factories in mechanical foam extinguishing. At the Krasnoiarsk factory a vacuum filter with a new type of filter tissue was used with some success in concentrating yeast. As a result, steam consumption for yeast drying was decreased by no less than 40-45%. It is very important to establish within a short time such vacuum filters in all yeast shops - this will permit a decrease in the net cost of production by 6-7%. The workers of the VNIIGS yeast laboratory should hasten to select and introduce yeast cultures with the highest yield in yeast shops.

Giprogidroliz and VNIIGs must accelerate the development and introduction of new types of apparatus, particularly vitaminizers that improve the vitamin composition of yeasts. New systems of apparatus should be developed and tested as soon as possible for the continuous growing of yeasts and insuring, at the same time, a reduction ein the consumption of electric energy. The adoptation of the injection system of yeast rinsing

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which has been tested in 1955 with some success at the Vyborg Sulfite-Alcohol factory (headed by tovarishch Andreev) must not be delayed any longer.

The realization of all of these measures should bring about a change in the development of yeast production and should raise it to a higher level.

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Twenty years of the hydrolysis and sulfite-alcohol industries.

Gidrol. i Lesokhim. Promysh. vol. 8, no. 8. pp.1-3. 1955. 301.8 G36

(In Russian)

The Central Committee of the Party and the Soviet Government, during the first Five-Year Plan put before scientists and engineers a problem to develop a technology, construct the equipment and organize industrial production of ethyl alcohol from wastes of sawmills and of woodworking industry.

This problem was successfully solved after wide scientific research and after successful mastering of ethyl alcohol production from wood pulp at the experimental Cherepovetskii Hydrolysis plant.

Twenty years ago, in December of 1935, the first Soviet Hydrolytic plant was put into operation. It was Leningradskii Hydrolytic plant. That same year, the first Soviet sulfite alcohol plant, as part of Sias'skii Cellulose - Paper Combine, began to put out alcohol from sulfite alkalies. In 1936 Bobruiskii Hydrolytic plant started operations.

Production workers, designers and scientific workers in this complex new work met with many difficulties but the Soviet Government gave great help during that period.

As a result of such cooperation, it became possible to obtain alcohol from nonfood raw materials in great quantities.

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In March of 1939, the 18th Party Congress when approving the third Five-Year Plan decreed that production of alcohol from sawdust and from wastes of paper industry must be increased.

In the spring of 1941, output of alcohol at the Leningradskii plant increased considerably, and the total yield of sugar vfrom raw materials amounted to 40%.

Khorskii and Arkhangel'skii Hydrolytic plants began to operate in 1940, while Saratovskii and Stalingradskii factories were set in action in 1941.

The sulfite-alcohol industry developed also. In 1938, an alcohol plant was set to work at the Kanskii, and in 1941, another at the Balakhinskii cellulose - paper combines.

During the first years of the war Leningradskii, Bobruiskii, Sias'skii and Stalingradskii alcohol plants were put out of action. Meanwhile during the war ethyl alcohol was especially needed for production of caoutchouc (a sort of rubber), of war supplies and medicine.

According to directives of the Government construction of new hydrolysis and sulfite alcohol plants was started in the Urals in Siberia. In 1942 there were put into action Sulfite-alcohol plants in Salikamsk, Arkhangelsk and Sokal. In 1943-1944 the first sections of Tavdinskii, Kanskii, Krasnoiarskii and Lobvinskii hydrolytic plants were put into action. In May 1944, I. V. Stalin told the people that these alcohol plants save millions of puds (pud= 36 pounds) of grain for the country.

During the war the hydrolytic industry made great progress in development of technics and of technology. A scheme for complex reprocessing of raw materials was introduced. Together with alcohol many of the factories started to put out protein yeasts and other products. At sulfite-alcohol

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plants preparation of concentrates increased very fast, which took place of vegetable oils in foundry work. In 1945 the prewar level of alcohol production was achieved.

At the end of the first postwar Five-Year Plan (1950) the plants, which were destroyed during the war, were rebuilt, as well as several new ones were added. Production of alcohol from nonfood raw materials grew more than 6 times compared to prewar levels.

In October 1952 the 19th Party Congress again decreed to give every possible assistance for the development of the hydrolysis industry.

Workers in hydrolysis and sulfite alcohol industries made great strides during the years 1950-1955 and their five-year assignments in alcohol production were already fulfilled by the middle of December in 1955.

In 1955, alcohol production rose by 2.7 times compared to 1950, and 11.2 times compared to 1946.

Innovators of the industry made many improvements. Method for fermenting unfiltered hydrolyzate was at first utilized by the workers of Tavdinskii, Krasnoiarskii and Leningradskii Hydrolytic plants. This made it possible to exclude, during production, the difficult and labor consuming process of filtration. The low-temperature system for neutralization of hydralyzates, which has sharply decreased the need for gypsum treatment of waste liquor columns, and combined delivery of hydrolyzate were first developed by specialists at the Kanskii and Krasnoiarskii pelplants; a new and much improved and simplified scheme of communications between hydrolytic sections, which was worked out by specialists and leading boilers at several of the plants, permitted to increase the productive capacity. According to the experience of Ferganskii and Khorskii hydrolytic plants, the industry started to introduce a system of hydrolysis with a decreased

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amount of water, which also increased the output of alcohol. As a result of all these measures the output of alcohol, using the same equipment, rose almost double.

Cost of one decaliter of hydrolytic alcohol decreased almost two times during the last 10 years and costs are now much below the alcohol obtained from grain. The first establishment that was constructed during the fifth Five-Year Plan, Biriusinskii Hydrolytic plant has paid for itself during 5 1/2 years of exploitation.

Workers at sulfite-alcohol plants also made great progress. Production of alcohol from sulfite alkalies in 1955 rose by 2.1 times compared to 1950, and 11.1 times compared to 1946. Output of alcohol per ton of cellulose was raised from 33.6 liters in 1946 and 47.6 liters in 1950 to 62 liters in 1955.

Concentrates obtained from waste liquor substituted for over 130 thousand tons of vegetable oil during years 1950-1955 in the smelting industry. Production of fodder yeast increased 4.6 times and of furfural 1.4 times. During the fifth Five-Year Plan for the first time there was organized an industrial production of new products from nonfood raw materials: vanillin from sulfite-alcohol waste liquor, trioxyglutaric acid from xylose, which is obtained during hydrolysis of cotton hulls, dry ice, and others.

Collective body of engineering - technical workers and workmen at the Leningradskii plant in 1948, with the aid of VNIIGs workers introduced into production the so-called "Leningradskii" method of hydrolysis of wood pulp. In 1955 they were the first to start production of "dry ice". Their establishment became an experimental base for VNIIGS.

Engineering - technical workers together with workmen of the alcohol plant at the Sias'skii Cellulose - Paper Combine were the initiators of

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fermentation of sulfite alkalies in tanks with a floating nozzle. They were also the first to organize production of vanillin. They introduced many innovations in construction of distillation apparatus. Output of alcohol per ton of cellulose was raised to 70-75 liters.

Names of various leading workers are cited from the following plants: Leninskii, Ferganskii, Khakasskii, Khorskii, Kanskii, Biriusinskii, Sias'skii Combine, Balakhinskii Combine, Kamskii Combine, Solikamskii Combine, Arkhangel'skii Combine, Priozerskii Cellulose plant, and Krasnoiarskii plant.

Yet many hydrolytic plants and cellulose - paper combines did not complete their assignments in alcohol ;production in 1958.

For better progress workers of scientific-research and of the planning institutes of hydrolytic and sulfite-alcohol industries must establish a close, creative and continuous cooperative work with institutes of the Academy of Science of USSR, as well as of Latvian and Uzbek SSR Academies of Science.

Efforts of scientists, engineers, technicians and inventors must concentrate on finding new,more effective methods for production, such as, continuous processes of hydrolysis of wood pulp and of agricultural plants wastes; continuous neutralization of hydrolyzates, automatization of basic technological processes, radical improvement of yeast production, utilization of radioactive elements, of ultrasonic vibrations, method of pulsation and other modern means for the intensification of chemical processes.

The problem is to surpass foreign science and technique relying on the advantages of Soviet regime. To ensure success, as leaders in the field of chemical reprocessing of wood pulp and of nonfood plant raw materials to

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glucose, ethyl alcohol, fodder yeast, furfural, and other products, is a matter of honour to Soviet workers of hydrolytic plants.

During the fifth Five-Year Plan the plant capacity for the newly constructed factories was raised 2-3 times.

It is necessary to introduce into production such innovations as, for instance, was developed years ago by a worker at the Ural'skii Institute of Chemical Machine - Construction; a scheme for boiling down sulfite wort before distilling it, which would save the expenditure of steam. Also to put into effect a new scheme, which was developed and tested by VNIIGS yet in 1948, for sulfite-alcohol production, of a preliminary boiling down of alkalies. Also the Ministry should look into using such large reserves for the increased output of both yeast and alcohol, as "predgidroliz" [prehydrolysis] of wood pulp at sulfite cellulose factories.

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Makrinov, I. A.

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[Aerobic method of fermentation and its use in agriculture and industry[1]].

Priroda, vol. 35, no. 8, pp.35-38. 1946. 410 P933

(In Russian)

The aerobic method of fermentation which I first published in 1940 (1, 2), attracted the attention of scientific institutes, the people's commissariates and various agricultural establishments. In view of the many inquiries which I have received concerning the possibility of utilizing this method, I consider it useful to describe briefly the results of my sixteen-years of work with this method chiefly in the realm of agriculture, and in part also in industry. A complete manual for the use of this method has been prepared for printing.

The aerobic method of fermentation is new, it was heretofore unknown, and has never been used. It is a much more improved method with regard to biochemism and more active compared with modern methods of carrying out bacterial processes. It has entirely original biochemical characteristics and a unique technical formation.[oformlenie].

The idea of this new fermentation method can be discerned from the following: Up to now every bacterial process was sure to be conducted in a liquid medium and in a vessel - conducting a bacterial process (with

[1] Report submitted at the Agricultural Section of the Leningrad House of Scientists, March 6, 1945.

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the exception of acetic acid fermentation) under conditions other than these was unthinkable. Yet under these conditions, in almost every bacterial process, there formed inevitably in the medium unfavorable and depressive conditions for the causal agents of the given process as a result of the development of vital products that are toxic or, at any rate, injurious to microbes. These products of vitality not only decrease the activity of the process, but they also thoroughly distort the very action exerted by the microbe upon the given fermentation product. As an example, we shall dwell on alcohol fermentation which is conducted as follows: a neutral culture medium is exposed to sterilization in a vessel in the course of which there occur exchange reactions between salts, salts and organic compounds and other changes. After the inoculation of such a medium which essentially is unknown to us after the sterilization, the process of fermentation begins: there form ethyl, amyl, and butyl alcohols, glycerin, succinic acid, acetaldehyde, the simplest monobasic acids, esters and other substances. These substances have a depressive effect upon the yeasts which now work in the acid medium poisoned by the products of their vital activity; as a result, the yeasts stop fermenting and, not having processed all sugar, bring the amount of alcohol to merely 16%.

Similarly, for instance, there form in pectin fermentation during the retting of flax intermediate products such as butyric, acetic, formic and valeric acids and other products that exert detrimental action upon the retting microbes and upon the fiber, retarding the process and decreasing the strength and color of the fiber. Here, a very characteristic instance must be noted - it is the formation of some extracts from the stems of fiber plants, such as tannic, oleoresin, rubber-like, pigmentary and other substances upon which the retting microbes produce practically no effect under

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these conditions. Many such examples can be pointed out in modern microbiology. Similar occurrences of unfavorable or even detrimental influence [Begin p.54] exerted by the medium upon the active microflora in the process are found, to a greater or lesser degree, in almost all bacterial processes and, hence, almost all of them are distorted and proceed incorrectly; such processes we describe as "abnormal".

Fig. 1. Apparatus for aerobic fermentation.
A - installation, B - lower basin, C- sprinkling apparatus, b - pump.

The facts cited above testify to the extent to which modern methods and processes used in producing bacterial procedures are abnormal. Hence it is natural to be asked - how can bacterial processes be conducted so that the active microflora within them would not experience the injurious, inhibiting action of the products of its vitality, nor of extract substances or other influences? Is the process to occur from beginning to end with a neutral reaction generally favorable to microbes? After extensive investigations we succeeded in developing such methods. For the time being, we shall dwell only upon one of them - the simplest, most inexpensive, most available and, a very important aspect, readily applicable to industry and agriculture. I have subjected this method to careful investigation.

This method is used on the apparatus depicted on fig. 1. It is constructed as follows: an installation composed of four posts (A) connected at the top and the bottom is erected on a platform; there is a basin (B) under the installation; a sprinkling apparatus (C) is arranged over the installation. The material to be treated is placed in the installation

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between the posts; mineral salts for microbe nutrients (0.05-0.1% of the weight of the material) and the corresponding ferments are added to it. Water is poured into the lower basin and then pumped over with the pump (b) into the sprinkling apparatus, from there it irrigates the material in fine sprays or in the form of rain, passes through it and is gathered up in the lower basin, from the basin it is again pumped over into the sprinkling apparatus. Such continuous or intermittent circulation takes place at certain intervals until the end of the process; the intermittent circulation is perferable because it decreases the work of the pump by at least 60-65% without hurting the process.

The description indicates that the given method is distinguished by simplicity and availability, but it has a unique and complex biochemism, to wit:

1) Every process carried out by this method proceeds in a neutral reaction which happens to be more favorable for microbe activity; this reaction is determined by wide accessibility of air into the loosely packed material and by energetically proceeding oxidation processes.

2) The active microflora is absorbed and concentrated by the material under treatment and is not dispersed in the liquid used in the treatments, as for instance in the case of flax soaked in a basin.

3) Enzymes of a given process are adsorbed by the mass under treatment in a colloidal body. Thus, all the strength of bacterial and enzymatic action is concentrated on the object of fermentation.

4) The material treated by this method possesses a remarkable, so-called "selective" capacity to absorb and retain substances needed for a given process [Begin p.35] and to lose the unneeded and injurious ones.

5) The process of aerobic fermentation is a sharply pronounced

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"specific" process that creates favorable conditions only for microbes of a given process and sweeps away alien and unnecessary microflora.

In the aggregate, the given method creates a maximum of favorable conditions for the activity of the causal agents of the process in progress; such conditions are not being created in modern microbiology for any bacterial process. We call such processes as "normal", i.e. processes proceeding normally.

Apart from these quite exceptionally favorable conditions for the process, the aerobic method has a number of other important economic and production advantages, to wit:

1) Utilization of air temperature acquired by the liquid used in treatment while it passes through the air; consequently, a warm climate, a warm time of the year, or simply a heated room are entirely sufficient [to enable one] to conduct the process at increased temperatures.

2) The small amount of water used by this method is determined by the fact that it has not been contaminated (absence of intermediate products) - thus 3-4 times less water is required when flax is retted by the aerobic method, than when it is soaked in a basin; the same is true of other processes.

3) The absence of unsanitary phenomena - a bad odor, contamination of treating liquid with unfermented products of vital activity.

4) The rather considerable speed of the process, for instance, retting fiber plants without being preheated is almost equivalent to thermal retting [1, p. 39, table 7].

5) The simplicity, availability and inexpensiveness of equipment and exploitation of the given method for various processes.

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6) Independence of climatic and weather conditions, since the process can be carried out in a room.

7) High-grade production and its standard quality.

8) The possibility of using the given method in considerably more processes and on more numerous objects, for instance, for retting certain plants that do not yield to anaerobic retting (indian hemp, the bark of a willow three etc.), for biological treatment of peat and vegetable waste for fertilizing, in biological protein enrichment of rough feed etc.

It is evident from the above that the given method represents an entirely new phenomenon: its chemism is such that it is capable of creating very favorable conditions for the vital activity of microbes - causal agents of the given process; it has considerable production and economic advantages and has been scientifically and theoretically substantiated.

This method has been tested and used in solving the most important urgent problems in agriculture and industry: 1) in biological retting of fiber plants, both, cultural and wild; 2) in the preparation of nitrogenous organic fertilizers and soil inoculations; 3) in biological treatment of rough feeds etc.

To be able to apply the given aerobic method to retting of fiber plants, it was necessary first of all to find aerobic retting agents which until of late have been almost unknown (with the exception of Bacillus comesii Rossi, which has been described very briefly and vaguely).

We have discovered and described in detail a series of new strains of microbial causal agents of pectine fermentation, to wit: Pectinobacter amylophilum [3], Bacillus cannabinus [4], Bacterium apocyni and Bacillus apocyni [5]. The use of these cultures as ferments produced positive results in retting fiber plants by the aerobic method.

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The technological process of retting, for instance of flax, by the given method consists of the following operation: after the loaded material has been irrigated for a short time, spontaneous heating, if necessary, can be conducted for the purpose of sterilizing the material against molds and "black rot fungi" (this operation is in most cases unnecessary); then it was set aside for 4 days, turned over once, and allowed to dry. [Begin p.36] After that it was put in storage for 2-4 weeks and then given the final treatment (kneading and beating).

The second agricultural process to which the method of aerobic fermentation was applied was the preparation of nitrogenous organic fertilizers. This process presents considerable difficulties to agriculture but is of great importance in view of the deficiency of organic fertilizers and the inadaptability of their microflora and composition to soil requirements: thus, for instance, manure, peat, composts and others do not have aerobic, nitrogen-fixing microbes, they, on the contrary, are dominated by anaerobic microflora and products of incomplete decomposition.

Modern world literature is devoid of artificial methods for biological conversion of peat into a fertilizer because it possesses substances that depress and inhibit microbe activity; hence, the removal of these substances from peat is the only means of securing its efficient biological treatment. This task can be performed best by the aerobic method thanks to its remarkable "selective" capacity to wash out and eliminate substances that are useless to the process and to retain the useful ones. This elimination of detrimental substances can be accomplished not only by a mechanical flow of water, but also by a unique biological selection of needed and useful substances that are consumed by the active microflora of cellulose and nitrogen-fixing bacteria.

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The work done in biological processing of peat and vegetable remains for fertilizers by the aerobic method has produced the following results:

1. Abundant multiplication of cellulose and nitrogen-fixing bacteria - reproduction of Azotobacter within the limits of 120-300 million per gm of dry peat [7, 9, 12].

2. Increase in nitrogen content within the limits of 0.16-0.22%, and in storage up to 0.5-1.0% [11, 12]; while the liquid used in treatments contains an even larger amount of nitrogen. Similarly, it was demonstrated by analysis that an increase of the nitrogen content in peat occurs not only as a result of the consumption of its organic substances, but also as a result of air nitrogen-fixation [11].

3. Reproduction, and activation of the basic, principal groups of soil microbes that determine its fertility (ammonifying, nitrifying), hydrolysis of urea, cellulose etc.) [9].

4. Accumulation of nitrogen in the form of readily assimilable compounds: free and absorbed ammonia, nitrates etc. [11]. This peat we call "bionitrated".

5. Decomposition of component parts of peat inassimilable by plants and their conversion into readily assimilable ones, to wit: decreasing cellulose by 8.16%, hemicellulose - 2.3 times, humic acid - 2.4 times, bitumens - 1.7 times; multiplication of nitrogen-fixing microbes occurs as a result of the decomposition of the above products [11].

6. Ample multiplication of nitrogen-fixing microbes occurs also in plant remains - Azotobacter up to 1 billion per gm of dried, treated material [8, 10].

7. Increase in nitrogen content up to 1% [8, 10]. These "bionitrated" plant remains and the "bionitrated" peat represent a new type of fertilizer -

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5. Decomposition of component parts of peat inassimilable by plants and their conversion into readily assimilable ones, to wit: decreasing cellulose by 8.18%, Hemicellulose - 2.5 times, humic acid - 2.4 times, bitumens - 1.7 times; multiplication of nitrogen fixing microbes occurs as result of the decomposition of the above products [11].

6. Ample multiplication of nitrogen-fixing microbes occurs also in plant remains - Azotobacter up to 1 billion per gm of dried, treated material [8, 10].

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aerobic, organic nitrogen fertilizer - in contrast to the modern anaerobic types (manure, peat, composts etc.).

8. Decrease of cellulose by 50%; according to anatomical and microchemical investigations - complete disappearance of pure cellulose, i.e. tissues that are stained by ClZnJ [sic] [zinc chloroiodide] a bluish purple color, and partial decomposition of wood by Moiles reaction.

9. Washing out and elimination of dark, brown-colored substances from plants (resinous, oily, tannic, wax-like, gum-like etc.), which is very important for feed purposes as well. [8, 10].

Remarkable results were produced in testing the influence of treated peat upon the development of plants and the accumulation of nitrogen within them in vegetative containers in a simple synthetic medium (sand, clay), i.e. under conditions of an accurate experiment.

Thus, bionitrated peat in a 3% dosage increased the yield by 6.8% [Begin p.37] (134.8 against 128.5 with saltpeter), in a 6% dose it increased the yield by 40.3% (compared to control with saltpeter) and in a 12% dose it increased the yield by 128.0% (against the control with saltpeter) [15].

An even more important and more interesting phenomenon was the influence of bionitrated peat not only upon the increase in yield, but also upon the increase in the nitrogen content within the latter. Thus, bionitrated peat in a 3% dose increased the yield by 15%, and the nitrogen content within it by 109%, and such peat administered in a 6% dose increased the yield by 58% and the nitrogen content by 120.65% [15].

In experiments conducted on field test plots bionitrated peat produced in one case a 66.9% increase in grain yield and a 34% increase in straw yield, in another case the grain increase was up to 40% and the straw increase up to 20%. In experiments with wheat conducted on field test plots,

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bionitrated peat produced a 47.7% increase in grain yield as compared with control, and a 35.5% increase in the straw yield [15, 25].

The preparation of nitrogenous organic fertilizers from peat and plant remains by the aerobic method with active nitrated microbes makes it possible to base soil productivity on the nitrogen-fixation process - in contrast to present day nitrogenous mineral and organic fertilizers - and to bring about a thorough reorganization of the production process in agriculture. These principles have been developed in detail in the handbook for the use of the aerobic method in agriculture, referred to at the beginning of the article.

As regards treatment of rough feeds, the aerobic method makes it possible for the first time to enrich them with protein as a result of the decomposition of cellulose and wood under the influence of cellulose bacteria and fungi; nitrogen-fixing bacteria which draw their nitrogenous nutrition from the air multiplied on the products of this decomposition: thus, the cells of Azotobacter numbered up to 1.4 billion per gm of dry straw, and nitrogen content had increased by almost 1% - (from 0.5% to 1.47%), and protein content had increased up to 8-8.4%, while pure cellulose, according to anatomical and microchemical analysis, was completely destroyed and raw cellulose (wood) was 16.8-50% destroyed [15]. Since fatty yeasts were introduced into the ferment [zakvaska], the fat content in treated straw increased up to 2-2.5% [15].

The last experiments that were conducted by an improved technological process, disclosed an even more intensive multiplication of Azotobacter and an increase in nitrogen content up to 1.8-2.0%, i.e. protein content up to 10.5-12.5%, under energetic decomposition of pure cellulose and wood [17]. Tests of such feed conducted on rabbits produced positive results [16].

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Much interest has been aroused by aerobic treatment of cellulose waste obtained in paper production for feed purposes, which we are conducting upon instruction from TsNIIB (Central Scientific-Research Paper Institute, Krasnokamsk Paper Trust). This cellulose waste represents 97% of pure cellulose and 2.5-3% of lignin. Cellulose bacteria and Azotobacter, in the form of powerful mucous colonies which subsequently decompose, and individual mucous cells are profusely multiplied on cellulose fibers. At 30°C, the amount of nitrogen reaches up to 2.8-3%, i.e. the amount of protein - up to 16-18%.

There is no doubt that other paper production waste will also be processed more effectively by the aerobic method; we have, for example, commenced work on the preparation of feed yeasts on sulfite alkali [17].

Treatment of manure by the aerobic method by the action of cellulose and nitrogen-fixing microbes has the objective of eliminating unnecessary or even injurious and very profuse anaerobic manure microflora which is responsible for the destructive work done during its storage. Substitution of this microflora by aerobic nitrifying cellulose and nitrogen-fixing bacteria will moderate and reduce consumption of organic substances nitrogen losses, and it will contribute toward its increase during storage [18].

The cost of peat treatment that lasts from 6 to 8 days, during which [Begin p.56] the pump works intermittently for only 66 hours, depends primarily on the consumption of electric energy. But this expenditure, too, will decrease considerably since it will be possible, as has been demonstrated experimentally, to utilize treated peat in combination with untreated peat at a 1:1:2 ration, equalling saltpeter in effectiveness in the first year's seeding and considerably surpassing it in the second year. This blend according to the estimated nitrogen content in untreated peat,

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for example, in the case of 0.5% N - at the rate of 6-9 tons/ha. In 2-3 years, the effect of this fertilizer will decrease its cost even more.

The aerobic method is very important in the preparation of soil inoculations which are a powerful factor in raising soil productivity, provided they are correctly prepared and applied, which is not the case at the present time. The problem of soil inoculations which were first suggested abroad, was developed here in the USSR by the author of these lines in a special monograph, in which the scientific and theoretical substantiation and methods for the application of soil inoculations to legumes [19] are given. On the basis of the results of this work, there were organized in 1916 experiments that produced positive results on a governmental scale [20]. Afterward we developed soil inoculations for cereals in the year 1917 [21] and their theoretical substantiation was given in a special monograph [22]. Unfortunately, in the last 15-20 years serious mistakes have been made in the preparation and application of soil inoculations which are used extensively in the USSR on hundreds of thousands and millions of ha, and these mistakes have considerably decreased the effectiveness of the inoculations.

It is obvious from the cited brief description of the results obtained from the aerobic method that it has introduced radical changes in the performance of the basic, most important processes practiced in agriculture and industry, and has given on principle new rules for the performance of such complex and work consuming processes as the retting of fiber plants, preparation of nitrogenous organic fertilizers, biological enrichment of rough feed with protein, preparation of soil inoculations etc. Such production can be accomplished very effectively by the aerobic method with an installation that is simple, inexpensive and fully available to kolkhozes and sovkhozes,

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that simplifies and renders less expensive all techniques of agricultural production and is totally independent of weather or climate at any time of the year. Such production, strictly mechanized and complying with previously established schedules would communicate to our kolkhozes and sovkhozes the character of commercial business establishments.

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Kitaev, A. V.

Unipoliarnaia elektrizatsiia aerozolia
v pole koronnogo razriada.

[Unipolar electrification of aerosols
in the field of the corona discharge].

Vest. Sel'skokhoz. Nauki, vol. 2, no. 9.
pp.127-131, September, 1957. 20 V633

(In Russian)

In agriculture and industry of the USSR aerosol treatments, that is application of atomized chemical substances to the surface of the treated objects, find a wide spread use.

It is possible to reduce the output of chemicals during aerosol treatments by increasing the dispersion of aerosols. However, during such treatments the quantity of the settling aerosols frequently is reduced to 3-6%, as the remaining part is carried away by the wind beyond the limits of the treated area and is lost.

During unipolar electrification the settling of aerosols is increased (4,6, 8). Aerosol is passed through a grounded metal tube along the center line of which a corona wire is strung. During feeding of continuous voltage the corona wire becomes surrounded with a thin concentric corona stratum from which in the direction of the tube's walls ions of the wire's sign [charge] are ejected into the aerosol.

In this electrically charged installation near every aerosol particle forms a complex resultant electric field, which is created by the outer field, the field of specular reflection of the ion relative to the particle's surface, as well as the field of its own and of the polarization charges.

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In its reaction on the ions the resultant field near the particle is divided into a zone of attraction and a zone of repulsion. In the zone of attraction the ions are driven to the particle by the electric field charging the particle up to the maximum charge, during which time charging ceases because the zone of repulsion disappears. Along with this, ions being in thermal motion collide with the particles, charging them up to that maximum charge when such a form of charge practically ceases. In both cases cessation of charging is explained by the intensification, in connection with the growth of the charge of the particle, of its own Coulomb field, which repels the ions.

During detailed examination of the process of charging the particles in time one has to compute both the directed movement of ions to the particle in the resultant electric field, as well as the movement of ions to the particle as a result of their thermal motion:

$$\frac{dx}{dt} = (k\nu E' - D \operatorname{grad}\nu)dS, \qquad (3)$$

where $\frac{dx}{dt}$ are the flow of ions to the surface of the particle, k - ionic mobility, E' - resultant field intensity, ν - concentration of ions, D - diffusion coefficient, dS - element of surface of the particle. It is more proper to apply this equation to the devoid of ions outer surface of the spherical layer which surrounds the particle and the thickness of which is of the order of half the length of the way of free range of the ion. In this layer the force of specular reflection of the ion relative to the particle's surface is great and the ion, which entered the layer practically instantaneously is absorbed irrevocably by the surface. In view of difficulties in solving equation #3, solutions were obtained only with specific simplifications. It proved, to be that during the final stage of the particle's charging in an electric field with intensity E depending on the radius of the particle r there predominated either the charge of the (Completion of sentence on next page)

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particle by the electric field, and then, according to Pauthenier (11), while the particle remained in the field of corona discharge $t \simeq \infty$ amount of elementary charges on the particle, or the maximum charge:

$$x'_n = (1 + 2\frac{\varepsilon - 1}{\varepsilon + 2})\frac{Er^2}{e} \qquad (1)*$$

there predominates either a charge of the particle by the thermal motion of ions and then, conforming to calculation, according to Deutsch's method, and taking into consideration Ladenburg's criterium, maximum charge was determined according to formula:

$$x''_n \simeq 3.10^8 r. \qquad (2)$$

Maximum charge x_n is taken as equal to the greater of the calculated, according to formula 1 and 2*. Formula 2 is valid only at a concentration of ions of $10^8 \frac{ions}{cm^3}$.

Nevertheless, from an examination of results of a calculation of the charge x''_n, according to the cited method, at different concentrations of ions ν it proved to be that formula 2 can be used during any concentration of ions ν in the range of 10^4 to $10^{10} \frac{ions}{cm^3}$, if a correction was inserted; during a greater concentration of ions the magnitude of the maximum charge, calculated according to formula 2, must be increased by $\lg(10 + \frac{\nu}{10^8})$ times, and at a smaller concentration decreased by [Begin p.128] $\lg(10 + \frac{10^8}{\nu})$ times. The, thus obtained, value of the maximum charge x''_n deviates not more than by 20% from the calculated, according to the Deutsch's method, and the magnitude of the correction is in accord with experimental data of Arendt and Kallmann (7). For a computation of the growth of the charge of particle x in time t one can calculate, according to N. A. Kaptsov's method (8), both forms of ions' motion to that part of the surface of the

* Here and later on all values are expressed according to system CGSE. Elementary charge, or charge of the electron $e = 4.8 \cdot 10^{-10}$ CGSE. ε is dielectric penetrability of the particle.

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particle of area $S_1 = 2\pi r^2(1 - \frac{X}{X'_n})$, which relates to the zone of attraction. For this surface the stream of ions under the influence of the electric field, according to Pauthenier, taking into consideration corrections of E. M. Balabanov (1) for the decrease of ions' concentration in the discharge interval $y = y_o(1 - \varepsilon\frac{x}{x_n})$, is represented by the first member of expression 4, where y_o is initial concentration of ions, ε = relative concentration of aerosol, or concentration of aerosol in fractions of maximum concentration. Such a concentration is called a maximum concentration of aerosol during which, with the absorption of all ions in the amount y_o, all particles receive a maximum charge.

In the zone of attraction, together with a directed motion, ions are also in thermal motion with an average arithmetical speed $\bar{v}$, forming a stream of ions per unit of area of surface S_1 in an amount $y = \frac{y\bar{v}}{4}$ ions per second, and for the whole area, in an amount $\frac{\pi}{2} y\bar{v} r^2(1 - \frac{X}{x'_n})$, which is represented by the second member of the expression 4, taking into account the decrease of concentration of ions.

From the zone of attraction utilizing their own energy of thermic motion ions can penetrate through the zone of repulsion to the surface of the particle which relates to the zone of repulsion especially, where the thickness of the zone of repulsion in a radial direction is close to the way of the free rune of the ion. This process is difficult to calculate, for its rough evaluation in the expression 4 we are introducing a third member which represents the flow of ions to the surface of the particle of an area $S_2 = 2\pi r^2(1 + \frac{X}{X'_n})$, which relates to the zone of repulsion.

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$$\frac{dx}{dt} = \pi ekx'_n \nu_0 (1 - \mathcal{E}\frac{x}{x_n})(1 - \frac{x}{x'_n})^2 +$$
$$+ \frac{\pi}{2} r^2 \bar{v} \nu_0 (1 - \mathcal{E}\frac{x}{x_n})(1 - \frac{x}{x'_n}) +$$
$$+ 2\sqrt{\pi r^2 \bar{v}} \nu_0 (1 - \mathcal{E}\frac{x}{x_n})(1 + \frac{x}{x'_n}) \times$$
$$\times \int_{\varphi_n}^{\infty} \varphi^2 e^{-\varphi^2} d\varphi, \qquad (4),$$

where $\varphi x = \sqrt{\frac{\varepsilon_e^2}{2hop}} : \frac{\sqrt{x - 0.5}}{\sqrt{r}} :$

Equation 4 is solved by graphic integration. If in the third member the integral is reduced to a tabulated integral of probability then for each value x value $\frac{dx}{dt}$ will be determined. If a concentration of aerosol is below the maximum concentration, then the maximum charge x_n; which was evaluated in conformity with this formula according to Ladenburg's criterium, is equal to the greater of calculated values according to formulas (1) and (2) in so far as in the last member polarization of the particle is not taken into account. If it would be taken into account then the maximum charge would prove to be near the value $x'_n + x''_n$. In the solution, which is presented in the figure, the mean kinetic energy of ion Lop and the mean arithmetical speed of thermal motion of the ion are accepted as equal to corresponding values of speed and energy of molecules of the air under normal conditions, although in the presence of an electric field these magnitudes are evaluated in relation to intensity of the electric field to the pressure of air (12), and the average arithmetical speed of the ion is evaluated besides that, by its mass (10). Curves in the figure are correct only in the presence of concentration of ions at $10^8 \frac{\text{ions}}{\text{cm}^3}$, (sentence continued after the title of the figure).

Title of the Figure:

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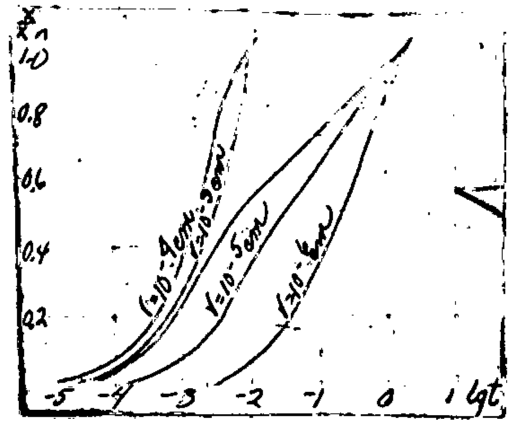

Title of the figures: The charge of particle x in fractions from the maximum charge x_n depending on the time of stay in the field of corona discharge t of particle of radius r at E = 50CSE,

$$v_o = 10^8 \frac{\text{ions}}{\text{cm}^3} \text{ and } \mathcal{E} \angle 1.$$

intensity of the field of corona discharge E = 50GSE and concentration of aerosol below maximum concentration.

Results of calculation of time of charging of particles according to formula 4 were compared at various concentrations of ions in the range from 10^4 to 10^{10} $\frac{\text{ions}}{\text{cm}^3}$. It proved to be that during any concentration of ions it is possible to employ the represented curves [Begin p.129] for the evaluation of the necessary time of stay of the particle in the field of corona discharge, if value t, found in the figure, is multiplied by $\frac{10^8}{\nu}$, for particles with a radius $r \geqslant r_o$ and by $\sqrt{\frac{10^8}{\nu}}$, for particles with a radius $r \leqslant 0.1 r_o$. For any other intensity of the field of corona discharge for rough calculations it is needed to equate the right parts of expressions (1) and (2) and determine the radius of particle r_o at which both mechanisms of charging are equivalent; after that on the curves of the figure indices $r = 10^{-4}$cm, $r \geqslant 10^{-3}$cm, $r = 0.5 \cdot 10^{-4}$cm, $r = 10^{-5}$cm and $r = 10^{-6}$cm must be substituted respectively by indices $r = r_o$, $r \geqslant 10 r_o$, $r = 0.5 r_o$, $r = 0.1 r_o$ and $r = 0.01 r_o$; then use these curves and introduce the cited correction for the difference in concentration of ions. If concentration of aerosol proves

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to be higher than the maximum concen[illegible]tion, then the curves in the figure can be utilized, bearing i[illegible] r[illegible] e given case the maximum charge is reduced by tim[illegible]

Rightfulness of su[illegible] experimental basis as much as the conditions fo[illegible] gi[illegible] its high concentration substantially differ from t[illegible] taken [illegible] n of formula 4 and, apparently, a certain part of aerosol remains practically uncharged. For providing a full charge of all particles the concentration of aerosol in the discharge interval must be near or lower than maximum concentration. In such a case one can substantiate the expediency for utilization of corona discharge for the purpose of reducing losses of chemicals during aerosol treatments.

Uniformly unipolarly charged polydispersed aerosol, consisting from n groups with a mobility $B_1, B_2, B_3, \ldots, B_n$, with a charge $q_1, q_2, q_3, \ldots, q_n$ and a correspondingly uniform computable concentration $n_1, n_2, n_3, \ldots, n_n$ in each group has such a characteristic that concentration of the i group of particles of aerosol with a mobility of particle B_i and the charge of particle q_i at any point of aerosol diminishes in time, independently of the form of the aerosol cloud, with the speed (13):

$$\frac{dn_i}{dt} = -\frac{4\pi B_i q_i n_i \rho}{\mathcal{E}_1} \qquad (5),$$

where uniform density of the volumetric charge of aerosol $\rho = \sum_{i=1}^{i=n} n_i q_i$. Diminution of computable concentration, or an electrostatic scattering at any point inside the aerosol cloud is carried out at the expense of the electric field of aerosol proper and is determined by the properties of aerosol in the point under consideration. Direction of motion of charged particles is determined by the direction of intensity of the electric field. It is possible to show, that diminution of concentration of i group of particles

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will proceed as before, in accordance with formula 5, during superposition over the aerosol's own electric field of any external electric field from external charges; nevertheless, the direction and importance of the speed of particles motion at any point of the cloud is determined by the intensity of the resultant field in this point.

As an example, let us examine the conduct of aerosol inside a horizontal endless flat layer of unipolarly charged aerosol of a thickness $2Z_0$ with a dielectric penetrability ε_1 and a uniform density of the volumetric charge ρ. Intensity of the electric field E' in the point with coordinate z with regard to the middle of the layer (coordinate z is positive to the lower half of the layer and negative to the upper half of the layer) is determined by integration of Poisson's equation in the form

$$\frac{dE'}{dz} = \frac{4\pi}{\varepsilon_1}\rho \qquad (6),$$

whence

$$E' = \frac{4\pi}{\varepsilon_1} \cdot \rho z \qquad (7).$$

In the middle of the aerosol layer at $z = 0$ the electric field $E' = 0$, that is why particles of aerosol are stationary there. In the upper half of the layer aerosol particles are driven up by the electric field, and in the lower half - down, that is aerosol is dispersed along the center line z up and down from the middle of the layer as it is described by Wolodkewitsch (13).

If the lower boundary of the layer represents a plane of demarcation between the aerosol and the substance with dielectric penetrability ε_2, then on the plane emerges a polarization charge which attracts the aerosol and which forms above the plane a, normal to the plane, uniform electric field with intensity (2).

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$$E'' = \frac{\mathcal{E}_2 - \mathcal{E}_1}{\mathcal{E}^1 + \mathcal{E}^2} E'_{z_0} = \frac{4\pi(\mathcal{E}_2 - \mathcal{E}_1)}{\mathcal{E}^1(\mathcal{E}^1 + \mathcal{E}^2)} \rho z_0 \qquad (8)$$

Here E'_{z_0} represents an intensity of the electric field of aerosol on its lower boundary. During precipitation of the charged aerosol on the plane there appears a true charge with a surface density n, which repells the aerosol and which recreates (above the plane) a normal to the plane uniform electric field with an intensity

$$E = \frac{4\pi n}{\mathcal{E}^1 + \mathcal{E}^2} \qquad (9)$$

[Begin p.130]

Regardless of the form of the treated object, this charge has an inherent quality to flow off to the earth. If leakages into the earth are eliminated, then the treated object becomes charged and the electric field of a true charge begins to counteract the precipitation of aerosol. At the same time intensity of the resultant field E inside the aerosol is determined by superposition of intensity of the field of polarization charges and intensity of the field of true charges

$$E = E' + E'' + E''' = \frac{4\pi}{\mathcal{E}1} \rho z +$$

$$+ \frac{4\pi(\mathcal{E}_2 - \mathcal{E}_1)}{\mathcal{E}1(\mathcal{E}^1 + \mathcal{E}^2)} \rho z_0 - \frac{4\pi n}{\mathcal{E}1 + \mathcal{E}^2} \qquad (10).$$

If the substance is a grounded conductor then $\mathcal{E}2 = \infty$ and $n = 0$, but

$$E = \frac{4\pi}{\mathcal{E}_1} \rho z + \frac{4\pi}{\mathcal{E}_1} \rho z_0 \qquad (11),$$

that is at the upper boundary of the aerosol layer at $z = z_0$ and above $E = 0$, below this boundary the intensity rises from zero to the value

$$E = 2E'_{z_0} = \frac{8\pi}{\mathcal{E}1} \rho z_0$$

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at the surface of the conductor. In other words, all the particles in the layer are driven by the electric field in the direction of the conductor, upon which equation 5 is correct as before at any moment of time t.

Let us evaluate (approximately) how the electroprecipitation of aerosol proceeded during our field experiments (4). From the lamellar electrocharging device emerged a layer of aerosol of a thickness $2Z_o = 60$cm at a density of volumetric charge $\rho = \nu = 0.6 \cdot 10^9 \frac{\text{ions}}{\text{cm}^3}$ under conditions of blanking the flow of the corona discharge. If one disregards the marginal effects, then, at the expense of settling, the concentration of droplets with a radius of 100 mc, 10mc and less than 1 mc, charged in the field of corona discharge up to the maximum charge, diminishes by 2.7 times correspondingly in 0.01 sec., 0.1 sec. and 1 second as it was calculated in the equation 5, assuming that settling of these droplets does not lead to diminution of density of volumetric charge ρ. During field experiments the basic mass of charged aerosol settled in the limits of 25m from the machine, where an increase in aerosol's settling was discovered because of electrification, while at great distances from the apparatus no substantial difference was discovered in settlings either with electrification or without electrification of aerosol.

During movement of the cloud over the soil and tops of plants induced charges emerge on the surfaces which are facing the cloud. Inasmuch as all the lines of intensity of the electric field terminate in these charges, then all the charged particles move to the mentioned surfaces with a speed $v = B_i q_i E$, which leads to diminution of concentration according to expression 5. Nevertheless, because of extraneous causes into the crown of plants can enter part of the charged aerosol cloud, which at that time is mutually screened by the conductive grounded surface of leaves from the remaining

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part of the cloud and the charges induced by it. One can assume, that the aerosol cloud within the crown is broken up by leaves and twigs into fully closed mutually screened cells with conductive walls. At the surface within each cell emerge induced charges which do not form any electric field only within a cell of such form for which the distribution of induced charges along the inner surface of the cell proves to be answerable to the solution of the problem of Roben (6); for instance, within a sphere, a perpetual circular cylinder, and so on. Inside such a cell aerosol particles disperse as if from an isolated cloud which has the form of a cell according to mechanism described by N. A. Fuks (6). In a general case the electric field inside the cell is determined by the solution of Dirichlet's problem; nevertheless for a rough estimate of the effectiveness of the electrification one can disregard the activity of induced charges.

CONCLUSIONS

If the construction of the corona electrically charged installation is such that aerosol finds itself there for about 0.01 second, and the concentration of the aerosol is near or below the maximum concentration, then all the aerosol particles can receive almost the maximum charge.

When leaving the corona installation the greater part of this charged aerosol during fractions of a second deserts the aerosol stream and then settles, in the resultant electric field of its own polarization and true charges, on the treated objects. From this point of view there is no special need for the provision over the treated object, with the aid of an extraneous source, of a high-tension precipitating electric field as it it is often practiced during electric coloration with a very disadvantageous

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dispersion of the electric field between the corona system and the treated object.

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Trans. A-872
(In part)
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Plevako, E. A., and Givartovskii, R. V.

Tekhnologiia drozhzhevogo proizvodstva. Ed. 2.

[Technology of Yeast Production].

Moscow, Pishchepromizdat, 1949. 277p. 390 G44T Ed. 2.

(In Russian)

p. 11-12.

At the beginning of the 20th century yeast production underwent a radical change, which led to a much higher yield of yeast from every unit of raw material at the expense of decrease in alcohol yield; this became so low that its distillation was not worth while. The expensive grain raw materials were replaced by wastes of sugar beet sugar industry, the so-called fodder molasses; out of these after proper processing, molasses wort was obtained; it was not added to the fermenting tanks all at once, but was poured in a continuous stream in amounts which were gradually increased according to the accumulation of the yeast mass in the yeast fermentor. To facilitate the assimilability of nutrients from molasses, the concentration of sugar was lowered in the fermenting tank to about 1° "Blg" [Balling ?]; by increasing the aeration the respiration of the yeast cells became activated; to ensure the predominance of yeast in its struggle against bacteria, which accompany it, seeding was increased to 15% in proportion to the weight of the processed raw materials; replenishing of component parts of raw materials, which were diffusing into the yeast cells was started with nutrient salts in strict conformity with [Begin p.12]

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the requirements of the whole mass of yeast, which was obtained as a result of production.

The new method came into practice under the name of the "influent" method. Already in 1925 this method was introduced to the Moscow Yeast plant during reprocessing of grain raw materials, and in 1927 when growing yeast on molasses.

Thus a yeast production was developed which did not produce alcohol at the same time and the title yeast - alcohol plant lost its appendage "alcohol". Thus, we have to do with special yeast factories, which produce baker's yeast; recently also there began to appear "fodder-yeast" factories, which produce fodder yeasts for the needs of animal husbandry.

At first the yeast plants put out pressed yeasts with a considerable admixture of potato and, partially, of corn starch. Since 1925 the amount of starch, which was added to yeast was limited to 20%, and since 1928 - to 10% in proportion to the weight of prepared yeast. Since 1929 it was prohibited to add starch to yeasts, and since then the factories produce only starchless pressed yeasts.

Tempoes of development of the yeast industry in USSR are characterized in Table 1.

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Table 1.

Growth (in percentage) of yeast industry in USSR during the period beginning with 1922/23 to 1940 (in relation to 1913/14)

Operative year	Growth in %	Operative year	Growth in %
1913/14	100	1931	236.6
1922/23 (October to October)	50.2	1932	253.3
1923/24	85.8	1933	258.4
1924/25	147.3	1934	288.5
1925/26	194.0	1935	367.4
1926/27	218.6	1936	467.5
1927/28	207.3	1937	566.5
1928 (January to January)	188.9	1938	661.5
1929	186.9	1939	695.1
1930	203.4	1940	743.8

It is seen from the table that utilization of starchless pressed yeast grew steadily in USSR.

Almost all the plants in USSR were changed over to molasses - influent method of production which increased the output of yeast twice compared to the yield from grain raw materials, and which, at the same time, simplified the process itself of yeast production. At the molasses-yeast plants together with the production of baker's yeasts, a production of fodder and food yeasts is being organized from nonfood raw materials, namely, wastes of hydrolytic-alcohol and paper-cellulose establishments, which contain the so-called hydrolytic sugar.

p. 99-103

<u>Hydrolyzates of agricultural wastes</u> are used for the production of food and fodder yeasts. [Begin p.100] Those agricultural wastes are usually

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subjected to hydrolysis which accumulate near industrial establishments (corn-cobs, hulls of millets, buckwheat and cotton, as well as straw).

Agrucultural wastes differ somewhat in their composition from wood wastes. (tables 16 and 17)

Title of table 16: Chemical composition of certain plant wastes (in % to absolutely-dry substances, according to data of N. I. Gutgerts).

Title of table 17: Composition of straw ash (according to data of Shtutser).

[Begin p.101]

The amount of easily hydrolyzed polysaccharides agricultural wastes is larger than in wood pulp; about 2% of the raw materials are composed of starches, pectin substances, and gums; often in millet and buckwheat hulls there is a considerable amount of starch in the form of grain remnants; carbohydrates of hemicelluloses compose 20-40% of the wastes weight.

Cellulose in agricultural wastes undergoes hydrolysis with difficulty and contains up to 16% of pentosan (in proportion to the weight of raw materials). Agricultural wastes have much more nitrogen, than wood pulp: 5-6% of the weight of ash in the straw of rye and wheat. Composition of ash varies in straws of different cereals. Total amount of ash in straw of rye, corn, wheat and barley comprises 4.0-4.86% of the weight of straw, and in corn stalks about 6.5%. There is about 4% of phosphorus (P_2O_5) in these wastes of the total amount of ash, and 20-40% of potassium (K_2O) (see table 17).

Hydrolysis of agricultural wastes is usually conducted in autoclaves under pressure up to 6 atm in 1-2% solution of sulfuric acid.

Chemical composition of hydrolyzates of agricultural wastes depends on the depth of hydrolysis. During full hydrolysis of hemicelluloses, besides uronic acids, xylose, arabinose, glucose, galactose, mannose, fructose and rhamnose form out of them (table 18).

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Title of table 18: Chemical composition of pentose hydrolyzates (in %).

Title of table 18 (second part): Chemical composition of hexose hydrolyzates (in %). [Begin p.102]

Title of table 18 (third part): Composition of reducing substances of the hydrolyzate (in %).

The process of hydrolysis of agricultural wastes was studied by N. A. Sychev, N. I. Gutgerts, and V. I. Sharkov.

According to N. I. Gutgerts' systems, cited below, hydrolysis of agricultural wastes can be accomplished in one or two phases.

Straw

Hydrolysis at 170°

Dry residue after hydrolysis (lignin)

Hydrolyzate, which contains and almost equal amount of hexose and pentose

Scheme I. Hydrolysis in one phase.

Straw

Hydrolysis of pentosans at 130-135°

Dry residue after hydrolysis (technical cellulose)

Pentose hydrolyzate, containing 85-90% of pentoses (by weight of the reducing substances)

Hydrolysis of cellulose at 170°

Dry residue after hydrolysis (lignin)

Hexose hydrolyzate, containing 75-80% of hexoses (by weight of reducing substances).

Scheme II. Hydrolysis in two phases.

[Begin p.103]

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While expending 0.75% solutions of sulfuric acid the length of hydrolysis equals 5-6 hours according to the first scheme. Yield of reducing substances in proportion to the weight of straw is about 50%. A fuller yield of reducing substances is obtained during the "two phase" hydrolysis. With such hydrolysis the first phase is carried out during the reaction with sulfuric acid solutions, taken in concentration of about 1%, in the course of 30 minutes. Under these conditions furfural is absent, yield of sugars, pentoses, is about 20-25% of the raw materials; total expenditure of acid consists of about 3.6% by the weight of dry straw.

Hydrolysis of difficultly hydrolysing carbohydrates is accomplished during the second phase. The chemical composition of hydrolyzates which are obtained from the two phase hydrolysis scheme is cited in table 18.

During the Great Patriotic War at small yeast plants a method of nonautoclave hydrolysis of agricultural wastes was practiced. The wastes were cooked in open wooden tanks during the course of 2 hours in solutions of sulfuric acid of a concentration of 2-2.5%, with a hydromodule 1:6. Yield of reducing substances from hulls of millets, buckwheat and peas constituted 28-30% of the waste when large quantities of sulfuric acid were expended, namely, 12-13% of the wastes (table 19). The thus obtained, initial hydrolyzate (without the washing water) with a concentration of 6-8% contained 3-3.5% of reducing substances and a considerable amount of furfural - about 0.5% (table 19). Hydrolyzates, while yet hot, were transferred to the neutralizing department of the yeast factory.

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Table 19

Expenditure of sulfuric acid during a nonautoclave method of hydrolysis

Title of wastes	Moisture in raw materials (in %)	Concentration of sulfuric acid solutions (in %)	Hydromodule	Output of sulfuric acid (in % to wastes)	Amount of reducing substances (in % to wastes)	Concentration of basic hydrolyzate (in degrees of Blg)	Amount of reducing substances in basic hydrolyzate (in %)
Millet hulls,	15	2.0	1:6	12	12	9	4.0
Buckwheat hulls	10	2.0	1:7	14	13.0	8	3.0
Pea hulls	16	2.0	1:6	12	12.0	6	3.0
Flour sweepings	110	1.5	1:8	12	10.0	12	7.0
Grain wastes (from seed separators)	10	1.5	1:8	12	10.0	9	4.7
Potato peels	80	0.8	1:19	15	3.0	6	2.5

Chapter Seven, p.198-205

PRODUCTION OF BAKER'S AND FODDER YEASTS FROM NONFOOD RAW MATERIALS

During the Great Patriotic War, yeast factories sprang up which produced yeasts from sulfite alkalies, or from hydrolyzates of agricultural wastes, wood pulp, as well as from waste liquor of sulfite - alcohol or hydrolytic-alcohol plants. Sulfite alkalies and hydrolyzates which enter the yeast plants represent sugar solutions of acid reaction owing to the presence in them of inorganic acids - sulfurous and sulfuric. Besides these, they contain various volatile substances - furfural, sulfurous gas, aldehydes, alcohols and terpenes, which harmfully influence the reproduction of yeasts. The colloids of hydrolyzates and of alkalies are adsorbed by yeast cells, hinder their normal growth and impart to them both a dark color and an unpleasant taste.

The basic distinction of the technological scheme of production of

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~~production of~~ food and fodder yeasts from nonfood raw materials is the processing of acid hydrolyzates and of sulfite alkalies before entering them into yeast fermentors also their neutralization and clarification. By blowing through large amounts of air during the process of neutralization a stirring of the medium is achieved; at the same time the medium is freed from volatile substances which are poisonous to yeasts. The following clarification permits to decant in a few hours a quite clear sugar solution, which is suitable for the reproduction of yeasts; clarification successfully replaces filtration.

During correct treating of hydrolyzates and sulfite alkalies it is possible to obtain high-quality white baker's and fodder yeasts from these waste raw materials.

Production of yeasts from nonfood raw materials proceeds according to a scheme which is cited on page 199.

A yeast plant which works with nonfood raw materials is composed of three shops: neutralizing - filtrating, dona or mother yeast, and commercial yeast shop. [Begin p.199]

Neutralization
↓
Freeing from harmful admixtures
↓
Filtration
↓
Reproduction of yeast
↓
Separation
↓
Washing
↓
Forming or drying
↓
Packing

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PRODUCTION OF YEASTS FROM SULFITE ALKALIES

Sulfite alkalies, which enter the yeast shop undergo careful processing: they are neutralized, freed from all substances which are harmful to the reproduction of yeast cells; they are clarified and cooled. Waste liquor from sulfite - alcohol plants also must be subjected to supplemental treating in that case when the sulfite alkali is not clarificed during the process of neutralization while alcohol is being distilled.

Sulfite alkalies are used to reproduce either the baker's yeasts, saccharomycetes, or saccharomycetes mixed with Monilia for a fuller utilization of all the sugars: both hexose and pentose. Sulfite alkalies, or the waste liquor from sulfite-alcohol plants are also used for production of fodder yeasts Monilia murmanica.

Sulfite alkalies, which vary in their composition, depending on the system by which cellulose was digested, have their peculiarities when they are converted into yeasts. They contain a large amount of nonsugars, that is owhy they must be strongly diluted with water, to a mean concentration of sugar of 0.8-1%. Small concentration of sugars does not ensure the necessary concentration of yeasts even if they yield is large in proportion to the raw material.

That is the reason why slightly different methods must be used when producing fodder or baker's yeast from sulfite alkalies or from hydrolysates, than are used at the molasses-yeast factories; namely: methods for continuous reproduction of yeasts must be adapted, also methods for recurrent separation, as well as by utilizing special aeration installations to reduce the expenditure of air and by mechanical means to suppress the formation of froth.

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<u>Neutralization.</u> Limestone is usually used for neutralization. It is ground in Black's crusher, ball mill, separator and two elevators. Besides limestone, they also utilize [Begin p.200] freshly slaked lime, which makes up one third of the total amount of neutralizing substances. It is permitted to re-use these substances many times, and, thus, they are expended only in the amount of 500 kg per 100 m^3 of sulfite alkalies which are being neutralized. Limestone, which is used for neutralization in the form of flour, must be so finely ground that it can pass through a sieve which has 1150 openings to 1 cm^2.

Slaked lime is used in the form of lime milk, in a concentration of 8° Blg and filtered through a fine sieve. Neutralization, as it is also done during sulfite-alcohol production, is carried out in special reinforced concrete towers lined on the inside with acidproof ceramic material. Pumps and pipe-lines, which come in contact with the raw material, the sulfite alkalies, must be made of acidproof material (for instance from phosphor-bronze).

For one hour before neutralization air is blown through the alkalies with the aid of a compressor; then neutralization of the alkalies is begun by adding lime milk up to pH 4.5-5.0; after this aeration is continued for 3 hours. For clarification of the alkalies, according to observations of P. N. Fisher, iron sulfate is successfully used, which is added to the alkalies in the form of a solution. Usually 80 mg of iron (Fe) is sufficient for 1 L. of alkali. Continuing the aeration of alkalies, slaked lime again is added and the pH is brought to 6.5-6.8. Then ammonium sulfate is added to the alkalies in an amount required for the reproduction of yeasts.

After the end of neutralization the alkalies are left to settle. After settling (in about 24 hours) the clear liquid is decanted from above

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the sediment; it is then filtered, while hot, in special filtering apparatus and is poured into mixer-tanks where it is mixed with water; after this it is drawn through a countercurrent cooler, which is able to lower the temperature of the alkalies down to 30°.

The neutralized alkalies are then directed into the yeast fermentors.

Reporduction of yeasts is divided into two stages: production of mother yeasts, ready for seeding, and of commodity yeasts.

Obtaining mother (dona) yeasts. Apparatus for the pure cultures are mounted in the form of one or two units.

The obtained pure cultures of saccharomycetes and pentose yeasts, each one separately, is passed through four accumulating phases; during this process they reach gradually a concentration, which will make it possible to obtain 20-30% of mother yeasts by weight; these must be reprocessed into baker's yeasts from sugar of sulfite alkalies.

During the first accumulating phase the waste liquor consists of 75% of molasses sugar and 25% sulfite-alkali sugar; during the second phase of 50% of molasses sugar and 50% of sulfite-alkali [Begin p.201] sugar; during the third stage of 25% of molasses sugar and 75% sulfite-alkali sugar, and, finally, during the fourth stage of sulfite-alkali sugar alone. During all the accumulating stages the latter must be contained in sulfite alkalies in the form of 1% solution. During every one of the cited phases reproduction of yeast is conducted at 30° and at pH= 5.8. Every phase continues for about 12 hours.

Waste liquor, which is intended for all four accumulating phases, is divided into two parts; in one of them, which comprises 2/3 of the total amount of waste liquor race XII, or race S is reproduced, while in the other, which comprises 1/3 of the total amount of waste liquor, the

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Monilia murmanica race.

At the plants, which produce fodder yeasts, 20% of the contents of the preceding tank are used for seeding the next yeast fermentor or they change to a continuous process of yeast reproduction. For this purpose every hour 20% of the tank content is pumped to the separators and the freed useful capacity of the yeast fermenter is filled with an equal amount of the culture medium, which contains, on the average, 0.8-1% of reducing substances.

Reproduction of commodity baker's yeasts can be conducted according to the usual air-flow process, utilizing methods of recurring separation. Yet, this process is less effective, than the new continuous methods which were adapted during the Second World War in the northern countries of Europe when yeast fermentors were equipped with aerator - ejectors.

Production of commodity yeasts from sulfite alkalies by a method of recurrant separation. Mother yeasts, before fermentation in yeast fermentors, pass through a preparatory fermentation, continuing for 4-6 hours. Thus, for two cultures of yeasts (race X11, or race S and Monilia murmanica) two tanks are required for the preparatory fermentation; out of these, one (for race X11) will have a useful capacity, comprising 2/3, and the other 1/3 of the total amount of waste liquor, which is intended for the preparatory fermentation. Into both of these tanks, taken together, are poured, in the cited proportions, 1/6 part of waste liquor from the main mash and 2-4% of yeast autolyzate, or extraction from 2-4% of malt sprouts (this percentage is taken in proportion to the general amount of reprocessed sugars in the main mash).

Reproduction of yeast in tanks for the preparatory fermentation pro ceeds under conditions of moderate aeration at a temperature of 30° and with

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pH= 5.6-6.0. When yeasts start to gemmulate intensely, then yeasts of race Xll are transmitted for seeding the main yeast fermentors and the race Monilia murmanica is brought in there about 4 hours later; thereafter their combined motion is revealed; it involves an almost full utilization of total sulfite alkali sugars while producing from them the baker's yeasts.

[Begin p.202]

Reproduction of yeasts in main yeast fermentors takes 12 hours and is conducted by the influent process utilizing a method of return separation. The amount of forced in air is estimated at a rate of 80 m^3 per hour per 1 m^3 of medium under conditions that openings in the air-distributing network have a diameter of 1 mm. Out of the total amount of medium, which is intended for reprocessing 20% enter the tanks for preparatory fermentation; then during the first 4 hours of fermentation in the main yeast fermentors the medium is fed at a rate of 5% (20% in all), and during the next 8 hours at a rate of 7.5% (60% in all). Starting with the 6th hour of fermentation the process of recurrent separation is begun; every hour one eight part of the useful capacity of the yeast fermentor is pumped off with a continuous and quite steady flow; and yeast, after being separated, is returned to the yeast fermentors in a continuous stream while the separated wort is directed to the sewer system.

After the completion of fermentation, yeast is left to ripen for 1-2 hours then it is separated several times and washed until wort has been completely washed off; aeration is going on during this process.

Of late, fodder yeast is produced by the continuous method; whereupon the continuity of a process lasts for 2-3 months. Tanks for this method of yeast reproduction have a special arrangement for aeration. They are supplied with so-called circulation pipes of special arrangement because

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of which the whole medium in the tank turns into a froth. After blowing in the air, which passes along the circulation pipes, the medium foams, and, owing to the fact, that specific gravity of the medium becomes lighter it rises along the circulation pipes and flows out in a powerful stream to the surface of the medium which is in the tank.

During reproduction of yeast in the foaming liquid it is necessary to provide for the elimination of the froth on its way to the separation station. Froth dampening is conducted in a special tank where the froth is destroyed by a stream of air which enters under pressure. With the aid of a floating arrangement liquid enters the separator's opening without froth.

Cooling off the liquid in the yeast fermentors is conducted by means of sucking off the frothing liquid by a pump and drawing it through a cooler. The cooled liquid then again enters the yeast fermentors.

This device successfully substitutes the coil pipes which are difficult to use for cooling a medium, when it is aerated by an apparatus that lowers the expenditure of water down to 25-30 m^3 per 1 m^3 of medium in yeast fermentors.

The speed of reproduction of yeasts is to a certain extent in proportion to their concentration. That is the reason why in sulfite alkalies or waste liquor, which are poor in sugars, it is possible to raise the speed of yeast reproduction by increasing the concentration of yeast in the medium; it is achieved by returning to the yeast fermentors those parts of yeast which were isolated in the separators. The concentration [Begin p.203] of yeast in this manner can be brought to 60 kg instead of 10-20 kg per 1 m^3 of the medium in yeast fermentors. In this way one succeeds to reprocess 700 m^3 of sulfite alkalies per a 24-hour day in yeast fermentors with a capacity of 150-200 m^3.

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PRODUCTION OF YEASTS FROM HYDROLYZATES OF WOOD PULP AND OF AGRICULTURAL WASTES.

As was cited previously, the production of yeasts from hydrolyzates of wood pulp and of agricultural wastes is conducted according to a scheme established for sulfite alkalies. Yet, neutralization of hydrolyzates is produced, in most cases, by lime milk with a specific gravity of 1.18-1.20. It is added in portions of 40-30 l as hydrolyzate fills the neutralizing apparatus (approximately every 3 m^3) which constitutes 12.5-15 l of lime milk per 1 m^3 of hydrolyzate. At that, the residual acidity of the neutralized material makes 2.5-3 ml N/1 NaOH, that is, 0.12-0.15% on conversion to sulfuric acid. Under the cited conditions the pH= 4.6-5.2. During neutralization the temperature is upheld at 90-95° and the neutralized hydrolyzate is aerated very energetically in order to free it from volatile substances which are harmful to the yeasts; furfural is thrown off mainly by the air. After removal of furfural neutralization is continued with slaked lime up to the pH= 6.5-6.8; then the hydrolyzate is left to settle and become clarified. At the conclusion of neutralization, hydrolyzate is filtered through a special filtering apparatus.

Professor N. D. Prianishnikov's method for freeing hydrolyzates from colloidal substances produces a much fuller clarification; during this method hydrolyzate is mixed with 0.5% phosphorite meal, containing 20% P_2O_5; the pH is brought to 5.8 with diluted ammonia and is filtered in a filter tub. During the above process a full coagulation of the sediment in the filter tub is attained and a perfectly clear hydrolyzate is obtained, which contains ammonium sulfate and ammonium phosphate that are easily assimilable by the yeast; the process facilitates obtaining white yeast and frees the hydrolytic factory from the necessity of utilizing superphosphate.

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Good quality yeasts are also obtained when the hydrolyzate is acidified with viscous phosphoric acid in the amount of 2.5 ml per 1 L of the hydrolyzate or 0.5% of superphosphate, after that adding chalk up to pH= 4.6 while aerating intensely with very finely dispersed air. Following this it is neutralized with lime milk up to the pH= 6.8, filtered, and the pH brought to 5.8 with sulfuric acid.

When reproducing yeasts in yeast fermenting tanks, the hydrolyzates are diluted with water to the content of sugars in them to 1%; the process of recurrent separation is not used because the hydrolyzates, unlike sulfite alkalies, do not have excessive density. Waste liquor from hydrolytic plants does not need to be diluted [Begin p.205] with water in the fermenting tank, because it contains only 0.7% of reducing substances.

One resorts only rarely to the preparation of mother yeasts when producing fodder yeasts from hydrolyzates; usually, the commodity yeast, remaining in yeast fermentors, serves as mother yeasts.

During the process of yeast reproduction the nutrient salts are introduced directly to the yeast fermentor. The new methods of continuous yeast reproduction, which were adapted in the practice of obtaining yeasts from sulfite alkalies, are also utilized for the production of yeasts from hydrolyzates.

EXPENDITURE OF NUTRIENT SALTS, OF WATER AND AIR

Expenditure of nutrient salts is expressed on the average in 115.78 kg of ammonium sulfate per 1 t of sugars, which will comprise 58.48 kg per 1 t of commercial yeasts, and 90 kg of superphosphate per 1 t of sugars, or 52.6 kg per 1 t of pressed fodder yeasts. Yet, one must take into con-

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sideration, that while reprocessing the strongly diluted hydrolyzates of wood pulp and of agricultural wastes, it is necessary to increase the dose of nutrient salts by 15-30% in proportion to their amount as expended according to calculations, cited in table 47.

Title of table 47, on page 204. - Expenditure of nutrient salts, of water and air at hydrolytic - yeast plants.

Output of water at hydrolytic-yeast plants is considerably greater than at plants which produce baker's yeasts as the concentration of sugars does not exceed 1% in the yeast fermentor.

Chapter 13 page 261

SIMPLIFIED METHODS FOR OBTAINING BAKER'S YEASTS

At the present time, new, much simpler methods for obtaining yeasts for baking, food and fodder purposes are emerging. At bread baking factories, where bread is made from low-grade wheat flours the so-called "liquid yeast" is used; virtually, they are "liquid ferments" - a mixture of yeast and acid-forming bacteria, which are reproduced on self-saccharified wheat mash. Yeast is not separated from the culture medium for the baking of bread. Bread factories use Professor A. I. Ostrovskii's method, described in special textbooks, for obtaining liquid yeasts.

In order to increase the total amount of baker's and fodder yeasts it is desirable to widen their production by utilizing as raw materials the wastes of other industries, for instance waste liquor from alcohol factories. R. V. Feniksova described a method for obtaining yeast from waste liquor of grain - potato alcohol factories by saccharimization of the residual starch with mold amylase. Fodder yeasts are reproduced on an in-

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dustrial scale from waste liquor of hydrolytic-alcohol plants.

Isolation of waste yeasts of molasses-alcohol factories is practiced under factory conditions according to a method, which was suggested by R. V. Givartovskii, and a simplified method for obtaining starch-containing wastes, developed by E. A. Plevako.

(continuation of p. 261)

OBTAINING BAKER'S YEASTS FROM WASTE
YEASTS OF MOLASSES-ALCOHOL PRODUCTION

At molasses-alcohol plants, which use speed methods for fermentation, the process in yeast fermentors comes to an end in 8 hours. During this process, on the average, 5.5% of yeast accumulates in the wort (calculating them as pressed) in proportion to the weight of reprocessed molasses. During the short period of fermentation yeast is very little subjected to the action of alcohol which gradually accumulates in the wort. Yeasts which are removed from the fermentor by means of separation in yeast separators and, which are thoroughly washed with water, are not inferior compared to the best pressed yeasts, which are produced at special yeast plants.

Chapter 14 p. 268-274.

PROSPECTS FOR DEVELOPMENT OF YEAST PRODUCTION

Yeast factories, as such, originated about 30 years ago; they produced baker's yeasts from grain raw materials, and this served as a beginning for a speedy improvement of technology of yeast production and for a radical change in the organization and equipment of yeast plants. Progress

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in such fields of science, as biology and chemistry assisted in the fact that yeasts ceased to be looked at as only a leavening for dough. They received a general recognition as being concentrates of protein substances which are vitally needed by men and animals, as sources of vitamin B complex and of pro-vitamin D. In connection with this, methods for reproduction of yeasts began to be thoroughly studied, as well as reconstruction of equipment at yeast plants and introduction, into the everyday practice, of the plants of new raw materials - wastes of other productions. It is only recently that by common efforts, made by researcher-theoreticians and by practicioners as well, it became possible to utilise all the carbohydrates of the grain raw materials for the reproduction of the yeast mass, that is to bring down to a minimum the accumulation of alcohol in the wort, and thus to lay a foundation for the formation of yeast industry. Following this the fodder molasses very rapidly succeeded to take place of the expensive grain raw materials in the yeast industry. In connection with the rise in demand for yeasts, as food and fodder medium, the modern air-influent method for reproduction of yeasts has emerged and became firmly established in the plant practice. A alarge yield of commercial yeasts per unit of molasses, naturally, brings down the price of yeast, which permits to use yeasts effectively as a fodder medium in animal husbandry.

As the bearers of rich proteins and of the complex of vitamins of group B, yeasts were studied by specialists in the field of animal husbandry as well as by medical men.

Of late the yeasts were studied still deeper and more thoroughly; a doctrine about yeast cells has been evolved, their classification and biology developed; research into their nutritive value was undertaken, as well as the degree of assimilation of the yeasts protein components. [Begin p.269]

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Wide use, in animal husbandry, of yeasts as supplement to the usual feed rations or in the form of concentrated protein fodder, in which are profitably combined the easily digestible, and vitally needed, complex of amino acids with vitamin B group, as well as with mineral admixtures, systematically led to acceleration in the growth of animals and of birds; increased the accumulation of meat, showed improvement of the quality of meat, raised the wool clip of sheep, with an improvement of the quality of wool, increased the milk yields in cows and goats, and, consequently, the supplementary production of butter and of milk products, helped greater endurance in horses, and so on. Besides this, when dry yeasts are irradiated with ultraviolet rays, vitamin D is created; this prevents development of rickets in young animals and reduces losses, caused by rickets, to a minimum. At poultry raising farms, when yeasts are utilized, egglaying is increased, the yield of first class meat is raised almost three times and the quality of down is improved.

Yeasts Monilia murmanica proved to be especially effective. In a dried form they should be made an indispensable part of the combined feeds. Addition of yeasts to feed rations should be in proportion to the weight of the animals. Mean daily dose of dried yeast consists of 1 to 2 kg per head of large cattle, of 0.5 to 1 kg per horse, 300g per sheep or goat, 200-600g per swine, piglets need 15 to 20g, and poultry 5-10% (in weight) of the feed ration.

Yeasts proved to be a good medicinal preparation. They are used successfully for a whole series of diseases, which are connected to one-sided, unrationed feeding, as well as to various disturbances of digestive organs. Yeasts are especially important for uplifting the general vital tonicity during emaciation, for regulation of metabolism which was dis-

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rupted in such cases. The presence of yeasts in the food ration permits to prevent a disease, which was named alimentary dystrophy and occurs because of insufficiency of proteins in daily food, or because of a disturbance of the ratio of nutrients in the daily ration of man.

Food preparations from yeasts, as observations have shown, strengthen the human organism, increase its resistance to infectious diseases, and relieve fatigue during strenuous work.

In bread baking yeasts are usually utilized only as leavening for the dough. It is possible to increase the amount of yeasts during baking of bread for the increase of its nutritive value. When introducing 3-4 times more yeast than it is required for bread baking, bread does not have any aftertaste, as it was ascertained by the works of Moscow Bread-Baking Institute. Bread, man's basic food, gives than a possibility to daily utilize yeast and by this to help improve the health of the population, to increase their efficiency. [Begin p.270]

During the Great Patriotic War, in connection with the growth of demand for yeast (source of protein food) a necessity has been created to increase the productivity of yeast plants and to utilize nonfood raw substances in the plants' practice. Researchers of various branches of science studied very thoroughly the air-influent method of production and on the basis of theoretical ideas, which sprang up at that time about biological properties of the special, quickly reproducing yeast cultures, have created new technological schemes, which permit to faster, fuller and simpler utilize the component parts of even such nutrient mediums as hydrolyzates of wood pulp, of agriculture, of sulfite alkalies, of waste liquor from hydrolytic-alcohol and sulfite-alcohol plants. Recently these schemes were utilized by the plants.

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The fund for basic raw materials for yeast production is enormous owing to a successful utilization for the production of fodder yeasts (and, in case of necessity, of baker's yeasts too) of waste sulfite alkalies, as well as of hydrolyzates of agricultural wastes (straw, stalks and cobs of corn, cotton husks, hemp tow, buckwheat and millet hulls, and so on), and of wastes of lumber industry (sawdust, chips, and so on). It became possible to combine the production of yeast from the cited kinds of raw materials with the production of alcohol, utilizing for this hexoses of hydrolyzates and reproducing yeasts in pentoses that pass over into waste liquor.

Other possibilities for cheapening the production became apparent under conditions where large factories established the production of yeasts from hydrolyzates.

A complex reprocessing of vegetable raw materials, for instance, has a great future when they will be treated with diluted acids by a method of hydrolysis, when at one and the same time ethyl alcohol and yeasts (from waste liquor) are produced as well as furfural, turpentine, raw methyl alcohol (from blown off vapors and condensates), and also carbon dioxide and the lignin briquets. Such a complex production would considerably reduce the cost of yeast compared to their production as a single item. Under such conditions gradually, hydrolyzate sugar will be able to displace the molasses raw materials from yeast production; molasses then can be converted to alcohol with greater effectiveness.

At the present time one can say with certainty that yeast will be used not only in bread baking, but also for medicinal purposes, in animal husbandry and poultry raising, as well as in public and individual nutrition. Demand for yeast will grow considerably.

At the present time yeast is utilized in other industries besides food and fermentation. Yeast is a very valuable raw material for obtaining

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new preparations, used in various fields of our national economy. It is possible to derive from them soluble proteins, vitamins, glutathione, nucleinic acid, enzymes, extracts for the production of bacterial remedies. [Begin p.271] That is why we face a tremendous task in organizing the production of yeast in quick tempos and in such quantities, which could fully satisfy the needs of our national economy.

No matter how great the achievements of the yeast industry were during the last ten years, they, nevertheless, leave a great scope for further research as in the field of methods for production processes, so also for their mechanization and automatization.

The new field of the industry, the production of fodder yeasts, requires a fast mastering of new methods, speeding up and simplifying the processes of production. It is necessary to decrease the holding capacity of yeast fermentors (it is here twice as big as in molasses-yeast production), and the expenditure of air; fodder yeasts are reproduced at low concentrations of sugar; the accumulation of yeast mass is only 20-25 kg per 1 m^3 of the medium instead of 45-50 kg per 1 m^3 which accumulate, for instance, at the molasses-yeast factories.

Hydrolytic-yeast factories utilize new apparatus, new aerators-ejectors, mechanical foam-dampers, roller or drum dessicators for drying yeast. Continuous reproduction of yeast, recurrent separation during reproduction of yeast on sulfite alkalies - all these methods are purposefully introduced into the industrial practice of fodder yeast production. These factories must give to the country cheap commodity production.

Fodder yeast plants must daily replenish protein resources of the country and utilize for this fast reproducing species of yeasts. It is known, that yeasts can form their protein substances of high biological value with amazing speed. Comparison of the speed of accumulation of protein

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in fodder barley during the time needed for the formation of a similar amount of proteins by yeasts indicates the following. From 1 ha of a field, with a yield of fodder barley of 130 puds (2080 kg), having 14% of protein substances per one vegetation period, that is for a whole year, the rounded off figure would be 300 kg of protein substances. A similar amount of protein substances is contained in 600 kg of the dry substance of yeast, that is in 2400 kg of pressed yeasts, which are reproduced in the course of only 12 hours. When the output of pressed yeasts is 60%, four t of molasses are required for their production; the molasses can be processed in one fermenting tank which takes room of 26.5 m^2. Thus, in a field of an area of 1 ha 300 kg of protein substances are obtained per year, while in a yeast fermentor taking room of 25 m^2, the same amount, and of a richer protein, is obtained during 12 hours.

The ever increasing demand for baker's yeast dictates a necessity for improvement of technological processes for this production too, and, consequently, also of the equipment in baker's yeast factories. [Begin p.272]

The baker's yeast factories face a problem to achieve a doubling of the raising power of yeasts, to eliminate the yeast washing tanks, to appropriate anew apparatus for mechanical clarification of molasses, to introduce into action combined pressing-forming-wrapping automatic machines, new aeration installations, mechanical foam-dampers, continuously working drying installations, which will produce dry baker's yeast that will keep its raising power for a long time. No less important is the mastering of automatization of the flow of the medium and introduction into the daily practice of self-recording and automatic apparatus which will help to control the production and its operation. The production of baker's yeasts, in the near future, must be converted to the continuous method of yeast reproduction;

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it is necessary to master methods of yeast production in hermetically constructed apparatus with blowing in of air which was sterilized with ultraviolet rays. All this will change also the configuration of the yeast plants; the result of this will be that the equipment of the factory will be compact, situated in a one-story building and equipped with short piping systems.

All these measures will lead to considerable cheapening of yeasts and to the improvement of their qualities.

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Kon'kova, E. A., Anisimov, A. A., and
Korchagina, L. B.

Intensivnost' fotosinteza pri vnesenii v pochvu bikarbonata kaliia v kachestve dopolnitel'nogo istochnika pochvennoi uglekisloty.

[Intensity of photosynthesis during application of potassium bicarbonate to the soil as an additional source of soil carbon dioxide].

Fiziol. Rast., vol. 3, no. 6. p.534-538, Nov./Dec. 1956. 450 F58

(In Russian)

It was established, by works of many authors, that during the process of photosynthesis for the formation of the organic substance of the plant it is possible to utilized not only the carbon dioxide of the air, which is assimilated by the leaves, but, to a certain extent, also the soil carbon dioxide, that is absorbed by the root system [1, 2, 3].

At the present time the attention of researchers is directed, for the most part, to the clarification of the influence produced by the root fixation of carbon dioxide upon separate aspects of the plant's metabolism. Apparently the physiological role of soil carbon dioxide, which is absorbed by the plant roots, is not limited only to the fact that it can serve as a supplementary source of carbon dioxide, although certain authors in their works give their main attention to this fact [4, 5]. Probably the root assimilation of soil carbon dioxide [2, 3, 6, 9] has a greater influence on the activization of the whole metabolism of the plant.

Taking into consideration the theoretical and practical import of the given problem, we undertook certain research on studies of the influence

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of potassium bicarbonate, as an added source of soil carbon dioxide [3, 7], on the intensity of photosynthesis. Experiments were conducted in 1954 and 1955. In this article results are given in a concise form.

METHODS

The experimental plants were grown on field sections in the botanical garden of the Gor'kov University, as well as in vegetative vessels under laboratory conditions.

As an added source of soil carbon dioxide in field experiments $KHCO_3$ was introduced into the soil at a rate of 80-120 kg K_2O/ha. Sections, where K_2SO_4 in equivalent amounts to K_2O was applied, served as control. NPK was the general background for both variants. In order to adjust the pH of soil solution, as a general background on all sections, lime also was applied (0.5 t/ha). Repeated examinations have shown that the exchange and hydrolytic acidities of the soil during the vegetative period on sections of both variants were the same. Soil on the section was light gray, forest; the pH of salt solution was about 6. Area of experimental sections was 10-25 m^2. Replication of the variants was triple.

In experiments with vegetative cultures Wagner's vessels were used with a holding capacity of 5.5 kg of the dry weight of soil. For their filling podzolic soil was taken, mixed in half with river sand. $KHCO_3$ (550 mg K_2O per vessel) also served as a supplementary source of soil carbon dioxide. Into the soil of the control vessels K_2SO_4, was introduced in amounts equivalent to K_2O. Replication for variants in vessels was fourfold.

Potatoes of Lorkh variety and cucumbers of Viaznikovskii variety were the objects of research in field experiments; beans of Borskaia variety - in vegetative vessels.

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For both the experimental and the control plants determination of intensity of photosynthesis was conducted during the same morning hours (from 8 to 12 o'clock) by the method of Ivanov and Kossovich and by the amount of carbon, which accumulated in the leaf (Tiurin's method, as developed by Borodulina and Kolobaeva [8]). In experiments of 1954 the evaluations, according to Ivanov's method, were conducted with leaves cut off from the plants and only the "observed" photosynthesis was rated; during experiments of 1955 the leaves were not separated from the plants and the "actual" photosynthesis was also evaluated, that is, respiration was also taken into consideration. The leaves were placed into conical flasks of 5 l holding capacity. Exposition in most cases did not exceed 7-10 minutes. In 1955 intensity of photosynthesis was also determined by Richter's method. [Begin p. 635].

During all determinations the situation of the leaf on the plant, the tier, and its position as to points of compass was taken into account. During the day (8 to 12 o'clock) 3 to 5 evaluations were made for each variant. In the tables, cited further, the mean intensity of photosynthesis is shown, calculated from these 3-5 determinations.

EXPERIMENTAL DATA AND THEIR CONSIDERATION

Results of the conducted research have shown, that introduction of $KHCO_3$ into the soil as an added source of soil carbon dioxide increases the intensity of photosynthesis at the expense of CO_2, which is assimilated from the air (tables 1, 3 and 4).

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Table 1.

Intensity of photosynthesis without taking into consideration the respiration; "observed photosynthesis" according to Ivanov's method

Date	mg of CO_2 per hour per 1 dm^2		Intensity of photosynthesis in % to control (K_2SO_4)	Tier (position on the plant)
	$KHCO_3$	K_2SO_4		
Cucumbers, field experiment in 1954				
July 19	12.8	11.6	110	7
" 20	14.0	13.0	107	7
Potatoes, field experiment in 1955				
July 9	13.11	9.82	133.5	6
" 11	16.60	9.06	161.1	6
" 14	7.70	6.30	122.2	5
" 15	9.20	4.95	185.8	6
" 21	11.80	9.42	125.0	12
" 27	10.55	8.02	131.0	12
" 30	12.34	10.08	122.4	

Table 2.

Intensity of respiration of leaves of potatoes, determined according to Ivanov's method. (Field experiment, 1955)

Date	mg of CO_2 per hour per 1 dm^2		Intensity of respiration in a variant with $KHCO_3$ in % to control	Tier
	$KHCO_3$	K_2SO_4		
July 11	2.70	3.70	73	6
" 14	4.30	3.70	127	5
" 15	4.30	3.20	134.2	6
" 21	2.72	1.61	130.1	12
" 30	5.54	3.94	140.5	12

Table 3.

Intensity of photosynthesis of potato leaves taking into consideration the respiration; "actual photosynthesis" according to Ivanov's method

Date	mg of CO_2 per hour per 1 dm^2		Intensity of photosynthesis in a variant with $KHCO_3$, in % to control	Tier
	$KHCO_3$	K_2SO_4		
July 11	19.30	12.76	152.0	6
" 14	11.97	10.00	119.0	5
" 15	13.47	8.15	165.0	6
" 21	14.52	10.93	132.8	12
" 30	17.34	14.02	124.0	12

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Thus, in the field experiment, in 1955, with potatoes the mean "observed" intensity of photosynthesis, determined according to the method of Ivanov and Kossovich, in overwhelming majority exceeded that of the control (K_2SO_4) by 22-33%. This correlation was maintained approximately the same also during evaluations of the "actual" synthesis. (table 3). During the field experiment, in 1954, with cucumbers this difference was smaller, of an order of 7-10%. Respiration in experimental plants (table 2) proceeded almost in all cases considerably more intensively compared to the control. Thus, on July 14 the intensity of respiration in experimental plants surpassed the intensity of respiration for control plants by 27%, and on July 21 even by 80% (an exception to this was the experiment on July 11, when a reverse picture was observed). In connection with this the correlation between the amount of CO_2 set free during the respiration and the amount of absorption of CO_2 during photosynthesis differed slightly for control and for experimental plants. Data in table 2 also testify that respiration of experimental and control plants proceeded very intensively and comprised, on the average, 23.9% of photosynthesis in experimental plants and 26.8% in control. [Begin p.636]

Results of evaluations of the intensity of photosynthesis, according to the method of Ivanov and Kossovich, in beans, which were grown in vegetative vessels (table 4) confirm data of field experiments. Here too was observed the positive influence of $KHCO_3$ upon the intensity of photosynthesis, and it was expressed to even a greater degree than in field experiments. Intensity of respiration of beans in vessels with $KHCO_3$ was also higher than in the variant with K_2SO_4.

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Table 4.

Intensity of photosynthesis in leaves of beans (experiment in vegetative vessels

Date	mg of CO_2 per hour per 1 dm^2		In a variant with $KHCO_3$ in % to control
	$KHCO_3$	K_2SO_4	
According to Ivanov's method "actual" photosynthesis			
June 16	8.13	5.53	147.0
June 30	4.67	3.88	120.3
According to Richter's method			
June 20	18.30	13.07	140.0
June 21	24.06	16.10	149.5
June 27	35.30	22.20	159.0

Table 5

Accumulation of carbon in leaves of cucumbers and potatoes

Date	Mg of carbon for 4 hours per 1 dm^2		$KHCO_3$ in % to control
	$KHCO_3$	K_2SO_4	
Cucumbers in 1954			
July 19	27.0	22.0	122.7
July 20	23.0	20.0	115.0
Potatoes in 1955			
July 14	43.33	24.17	159.0
July 21	38.50	30.28	127.0

Such an extent in difference among the variants was also obtained during the determination of intensity by Richter's method and that of Bordulina in leaves of potatoes and cucumbers on the field sections and in leaves of beans from vegetative vessels (tables 4 and 5).

Table 6.

Influence of $KHCO_3$ on the size of leaf blades of beans in vegetative vessels (in cm2). (average per 1 plant), experiment in 1955.

Date	Variants of experiments	Replication by vessels (in each vessels 10 plants were examined)				Average in a variant
June 15	$KHCO_3$	27.2	23.2	31.4	30.2	28.0
	K_2SO_4	21.6	20.4	22.0	24.5	22.0
June 20	$KHCO_3$	69.4	61.5	54.9	54.3	60.0
	K_2SO_4	40.8	50.6	42.9	49.1	45.9
July 1	$KHCO_3$	77.5	76.4	68.7	74.0	74.1
	K_2SO_4	50.2	54.2	62.5	57.7	55.9

One should note, that the size of leaf blades in experimental plants was almost in all cases larger than in the control (table 6). That is why estimation of the degree of efficiency of photosynthesis has shown the presence ~~of photosynthesis has shown the presence~~ of still greater differences among the

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variants, than on the intensity of photosynthesis. [Begin p.557]

Table 7.

Contents of chlorophyll in experimental plants

Plants	Date	mg of chlorophyll per 100g of dry weight		$KHCO_3$ in % to control
		$KHCO_3$	K_2SO_4	
Potatoes	July 25	208	198	104.8
Beans	June 24	305	291	104.8
Beans	July 1	308	265	116.6

Because by the methods of Ivanov and of Richter only that amount of carbon dioxide, which is assimilated from the air, is determined, the obtained data permitted us to come to conclusion that when introducing $KHCO_3$ into the soil not only the entrance of carbon through the roots [3,7] is increased, but photosynthesis is also activated at the expense of carbon dioxide of the air. $KHCO_3$, as an added source of soil carbon dioxide raised also the intensity of respiration of experimental plants and increased the content of chlorophyll in the leaves (table 7). All this attests to the general activisation of metabolism during root assimilation of soil carbon dioxide [2,3].

The obtained experimental data are not yet sufficient in order to make definite conclusions about the causes for increase of intensity of assimilation by leaves of CO_2 from air when potassium bicarbonate is introduced into the soil. The doses of $KHCO_3$ used by us were such that they could not raise the concentration of CO_2 in the air to any noticeable degree during a possible decomposition of this salt. This was confirmed many times by conducted evaluations of the content of CO_2 in the air over the sections fertilized with $KHCO_3$ and K_2SO_4.

Undoubtedly, to some degree the activisation of photosynthesis is connected to an increased content of chlorophyll in experimental plants.

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One can assume that a definite role is being played here by the increased synthesis of amino-acids in the roots, which help in the formation and accumulation of proteins in plants during root assimilation of soil carbon dioxide [2,6]. Along with determinations of intensity of photosynthesis, in field experiments with potatoes (1955) we also analyzed the roots and sap of experimental plants. Analyses have shown that in the variant with $KHCO_3$ both the roots and the sap contained much more amino-nitrogen, than on sections with K_2SO_4 (table 8).

Table 8.

Contents of amino-nitrogen in roots and in sap of potatoes (field experiment in 1955).

Roots (in mg per 1g of dry weight			Sap (in mg per 1 ml)		
Date	K_2SO_4	$KHCO_3$	Date	K_2SO_4	$KHCO_3$
July 2	3.68	7.32	July 8	0.0140	0.2430
" 11	3.71	9.99	" 10	0.0028	0.0060
" 22	1.71	2.26	" 14	0.0103	0.0136
" 26	1.98	2.49	" 18	0.0098	0.0156
" 29	1.86	2.67	" 30	0.0039	0.0142

Apparently, the increased synthesis of aminoacids in the roots causes a vigorous consumption of carbohydrates and of those organic acids that are formed from them, what, in turn, leads to a quick emptying of assimulants from the leaves and to their runoff into the roots. The latter case can well be one of the direct causes for acceleration of photosynthesis during root assimilation of soil carbon dioxide. [Begin p.538].

CONCLUSIONS

1. During introduction into the soil of potassium bicarbonate, as an added source of soil carbon dioxide, the intensity of assimilation by

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the leaves of CO_2 from the air is raised, the content of chlorophyll in them increases, respiration intensifies.

2. One of the possible causes for the more active assimilation of the air carbon dioxide during introduction of $KHCO_3$ into the soil probably is the intensified synthesis of aminoacids in the roots. This must produce a vigorous output in the roots of carbohydrates, as well as of organic acids formed from them, as well as to increase the runoff of assimilants from leaves into roots. The latter can well be the direct cause for acceleration of photosynthesis.

A definite role in this respect is played also by the increased content of chlorophyll in the leaves of plants which received potassium bicarbonate.

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Balakhovskii, S. D.

Problemy vitaminologii
(Vsesoiuznoe soveshchanie)

[Problems of vitaminology
(An All-Union Conference)]

Vestnik Akademii Nauk SSSR,
vol. 27, no. 9, pp. 123-126.
Sept. 1957. 511 Ak14V

(In Russian)

After a ten-year interruption, the regular 4th All-Union Conference on Vitamins was held at Moscow in the building of the Faculty of Soil Biology of the University on the Hills of Lenin. The Conference was called on the initiative of a number of institutions that are interested in the development of the practical use of vitamins as well as in their theoretical investigations - the Academy of Sciences USSR, the Academy of Medical Sciences USSR, VASKhNIL [All-Union Academy of Agricultural Sciences im. V. I. Lenin] and several Ministries. Each of these institutions approached the vitamin problem from its own point of view, which was reflected even in the Conference program; the great variety of reports lent it a somewhat bizarre character.

During the 5 days of Conference work (from the 20th through the 25th of May) more than 270 reports were read; 3/4 of them were applied and survey types devoted to problems of the raw material base, production of concentrates, treatment of food products, preservation of vitamins etc. The problem of vitamin synthesis received comparatively little attention - a total of 18 reports. Analysts displayed a somewhat greater activity having presented over 30 reports. Furthermore, not all of the reports from their section

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re devoted to analytical problems. For unknown reasons, the analytical section had devoted part of its time to general reports on vitamin P. This problem aroused real interest: tea tannids possess the action of vitamin P and contribute toward the prevention of vascular diseases (including a decrease in the strength of vessels); Prophylaxis of these disease is achieved also by several new preparations, namely by "rutin", catechins of tea leaves and others.

To what type of problems did the vitaminologists pay the most attention? To some extent this is indicated by the distribution of the reports. Thus, in the biochemical and physiological section 53 reports were heard, in the medical section 61, public nutrition and use of ~~vitams~~ vitamins - 40, animal husbandry - 50, methods of vitaminological analysis - 32, chemistry of vitamins and their synthesis - 18, technological vitamin production - 30.

If chemists-synthesists together with biochemists and physiologists were separated into a group of "theorists", then the reports submitted by "practitioners" would still comprise 78% of the total number. Furthermore, this figure was enhanced to some extent by the fact that a small number of biochemical and physiological reports was added to those of the medical section because of their practical importance.

The interest manifested by the Conference delegates in various vitamins was by far not identical as can be seen from the list below:

Vitamins	Number of reports
C (ascorbic acid)....................	43
A and related substances (carotene)	35
B_{12}	27
B_1 (thiamin)	21
PP (nicotine acid and its amide) ...	19
B_2 (riboflavin)	15
D_1 D_2 (antiricketa)	14

List continued on next page

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Vitamins	Number of reports
P (citrin and others)	13
E and tocopherols	9
B_6 (pyridoxin)	8
B-group (as a whole)	7
Folic acid	3
Pantothenic acid	2
Choline	2
H (biotin)	2
K and its analogs	2
B_x (Paraaminobenzoic acid)	1

[Begin p.124]. The rest of the reports (60) are surveys and on "vitamins in general". Reports on vitamin F, lactation vitamins and inosites were completely absent.

It was a conspicuous fact that most reports had been devoted to Vitamin C although the question concerning it had been developed more than others from a practical point of view. The synthesis of ascorbic acid has been well aligned, simple, yet at the same time promising methods for its determination have been created, its distribution in nature and its content and preservation in food products have been amply described in literature, and excellent preparations of it are being released. It is possible, even though it seems paradoxical, that the very availability of vitamin C and the methods of working with it have been responsible for its selection as a topic by some researchers.

It must be noted that the reported works on vitamin C contained much that was interesting, as, for instance, the discovery of the relationship between nucleoprotein metabolism and ascorbic acid, the investigation and synthesis of iron ascorbinate etc.

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As noted above, an extensive group was composed of reports devoted not to any one vitamin, but to vitamins "in general". The report "Concerning the physiological mechanism of vitamin action" can serve as an example.

In this category belong a series of surveys and a large number of technological reports.

Reports that dealt with the study of mechanism of action of individual vitamins were few, but some of them enable one to arrive at generalizations and indicate possible new trends, new means of developing research. These works concern not only vitamin C, but vitamin A, E, K, and complexes of fat-dissolving vitamins and proteins as well. Data of a series of biochemical reports dealing with the formation of a protein complexus with sterols and some vitamins enable pathologists to approach the problem of sclerosis from a new point of view. It must be assumed that practice will similarly find the starting points required for new achievements in work devoted to the mechanism of vitamin A action and its inhibitive influence upon copper catalysts, tissue hormones and mediators (acetylcholine, adrenalin). Reports on the role of vitamins and possible avitaminosis in plants were very interesting.

A good deal of attention was paid to the separate aspects of the use of vitamins in animal husbandry. There is, however, no doubt that if animal breeders had considered realistically the economic effect that the use of vitamins could produce in the different branches of animal husbandry and would have shown in figures to what extent the productivity of any of these branches could be increased by adding vitamins to the usual animal feed, then their work would have attracted much more attention and would, naturally, have been a great deal more useful.

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The Conference drew up an extensive resolution stating that "on a number of items Soviet vitaminology had achieved substantial successes." There is no doubt about that, but it is not known why "evidence of the circumstance that vitamins not only protect the organism against avitaminosis, but possess also a pronounced capacity to increase the vital properties of the organism aiding it in the control of unfavorable influences, including infections, as a result of which an increase in the degree of vitamin nutrition up to a physiologically optimal standard must be considered as one of the most important factors in the over-all system of prophylactic measures" is presented as "the most important result". This was discussed a quarter of a century ago at the first conference held on vitamins, when the vitamin industry was barely more than a novelty; such very elementary and generally known information was scarcely worth including in the resolution of the present Conference.

The Resolution disclosed a number of shortcomings in vitaminological work and it contained suggestions for a direction that, in the opinion of the Conference delegates, it should follow in the future. The resolution includes a large number of recommendations for vitaminologists such as those providing for the development of synthesis of biotin, inosite, choline, and pantothein, organization of the production of vitamin concentrates [Begin p.125] especially for animal husbandry, creation of a scientific-methodological center to deal with problems of agricultural vitaminology, and publication of a special journal.

The resolution contains also a program for scientific-research on vitamin problems in the sphere of medicine. The attention of the Ministries of Public Health of the USSR and the Union Republics has been called to the need of solving a number of very real problems (even though some of them are not

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new), such as the influence of vitamins upon the resistance of the organism to infectious and other diseases, radiation action, antitoxic action of vitamins, and their influence upon the course of pregnancy, pharmacological action of vitamins in various diseases and their reciprocal relations with antibiotics, sulfamides and other therapeutic substances.

Much attention was focused in the resolution on the use of vitamins in animal husbandry. The existing status was criticized and the introduction of vitamins to animal husbandry practice is considered as entirely inadequate. It was pointed out that the reason for it is the continued minimizing in some institutions of the importance and the desirability of using vitamins as an effective means in preserving the stock and in increasing the productivity of agricultural animals and poultry. The resolution noted a plan for the development of vitamin research applicable to problems of animal husbandry and it recommends the plan to the Institutes of the Ministry of Agriculture USSR and to the All-Union Academy of Agricultural Sciences im. V. I. Lenin.

This plan includes the further development of the dosages of vitamins to be introduced in the different feeding and maintenance regimes of cattle, a study of vitamin influence upon the productivity of animals, the effectiveness of their combination with microelements, antibiotics and substances of similar action, an explanation of the mechanism of vitamin action in the animal organism, and the investigation of a series of veterinary and applied questions.

The works of nearly 400 scientific fellows of various institutes were discussed at the Conference. As noted above, reports of an applied character were numerous and contained a considerable quantity of valuable material and suggestions. However, as far as the works of a scientific-theoretical character are concerned, the evaluation has to be more restrained. This is regretable, for it is known that in the wake of every important theoretical achievement

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there emerge and develop "with the speed of an explosion" whole series of practical applications. To more than 20 vitamins which represented several multiples-of-ten of chemical compounds, there were only about 60 physiological-biochemical reports. This, of course, is entirely inadequate.

There are many reasons for a situation of this sort which we cannot examine now. One of them, however, is of more special interest since it is connected with the problems discussed at the Conference.

If, from a practical point of view, the existence of a class of "vitamins" is very expedient in-as-much as it includes substances that have to be introduced into an organism in finished form, then the existence of such a class is not justified from the scientific point of view. Very many substances form within the organism - biocatalysts whose functions are very similar to the functions of vitamins. Vitamins differ from such substances merely by the fact that they are "imported" for the organism, but their functions do not change because of it. A similar viewpoint becomes increasingly general, and in international terminology the term "vitamin" is being replaced by the individual names of the compounds. Thus, the "vitamin" topic loses its specificity for a number of researchers and finds its place under the conventional physiological and biochemical topics.

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Trans. A-875
(In full)
VG/A

875

Kasatkina, I. D.

Primenenie bakterial'nykh fermentov dlia regeneratsii triatsetatnoi plenki.

[Use of bacterial enzymes in the regeneration of triacetate films].

Vestnik Akademii Nauk SSSR, vol. 27, no. 9. pp.77-78. Sept. 1957. 511 Ak14V

(In Russian)

In connection with the switching over of the motion picture film industry to the production of non-combustible triacetate films, the problem of regeneration of the by-products of these films, i.e. the removal of the emulsion layers and sub-layer of gelatin from their surface, has assumed great importance. The emulsion comes off readily when a film is treated with hot water, but the gelatin sub-layer is difficult to remove. Various chemical substances are, for a number of reasons, also inadequate for this purpose. Testing of proteolytic bacterial enzymes in the removal of photographic emulsions and sub-layer gelatin from a triacetate film was of definite interest.

Some bacterial proteinases are selective and exert action only upon certain proteins - gelatin and collagen (a precursor of gelatin). They were given the specific name of gelatinase. In addition to proteinases, bacteria form a series of other proteolytic enzymes (peptidases, desaminases, desamidases) which exert action upon the products of protein hydrolysis and bring about their complete decomposition into ammonia. However, in the removal of sub-layer gelatin from a triacetate film, proteinases which transform gelatin by means of hydrolysis or by changing its dispersity into a

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soluble state are especially important. Other enzymes which involve a more thorough decomposition of the protein molecule are, apparently, less important to the given process.

The Institute of Microbiology of the Academy of Sciences USSR, in cooperation with the motion picture film factory No. 5 of the Ministry of Culture USSR, had undertaken research aimed toward developing a method for the production of bacterial enzymes that would prove suitable for the regeneration of triacetate films. Investigations were conducted with a culture of Bac. mesentericus of the "PB" strain which possesses greater proteolytic activity. The culture medium used in growing bacteria and in their production of proteases was a synthetic medium of a fairly simple composition: gelatin - 1.0%, NH_4NO_3 - 0.1%, KH_2PO_4 - 0.1%, $MgSO_4$ - 0.06%, NaCl - traces, $FeSO_4$ - traces, water (from a faucet) - 100 ml; pH was brought by alkali up to 7.0 - 7.6.

A medium of a similar composition was of interest for two reasons. In the first instance, cultivation of bacteria on a medium containing gelatin as the only source of carbon assumed the adaptive strengthening of their proteolytic enzymes under the influence of this specific substrate. In the second instance, the growing of bacteria on such a medium was advantageous for the factory, since gelatin is a raw material available for cine-film production. Inoculation of the medium was carried out with a suspension of the cells of Bac. mesentericus grown preliminarily on meat-peptone agar at 37° [C]. On this medium bacteria multiply most intensively [Begin p. 78] and form a coating on its surface, or a thick bacterial cloud in deep cultivation in large bottles with aeration of the medium.

A cultural liquid of the required activity was obtained after two or two-and-a-half days [60 hrs] if the bacteria were grown on the surface, and

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after 24-36 hours when grown by the deep method (its proteolytic activity was determined viscometrically, in accordance with the intensity of liquefaction of an 8% gelatin solution).

To eleiminate even the slightest possible danger that the cells of Bac. mesentericus might infect the factory's other shops in which work was conducted with moist gelatin, it was extremely important to insure that the liquid enriched with proteolytic enzymes did not contain vegetative cells or spores of the given microorganism. For this purpose it was put through the SG-1 separator in order to separate the basic bacterial mass, and then filtered through Seitz asbestos filters.

A dry enzyme preparation can be prepared from a cultural liquid by one of the following methods: precipitation of enzymes from the solution by protein precipitants, adsorption of enzymes by various agents (carbon, kaolin etc.), and drying of the liquid that contained enzymes. [The method] used in the experiments described was precipitation of enzymes from the liquid by means of ammonium sulfate (0.7 kg/l). The filtered and dried precipitate possessed considerable proteolytic activity after dissolution. There is, however, no need to obtain a dry enzymatic preparation in those cases in which a liquid enzymatic preparation can be used immediately upon its preparation.

A 15-minute treatment of a film with cultural liquid will remove sub-layer gelatin from a freshly coated base or from emulsified films, either black-and-white or colored. However, in testing old film samples or a coated base, the time required for gelatin hydrolysis is 45-60 minutes, since the gelatin, as a result of long storage and the influence of formalin, becomes hardened [zadubilvaetsia] and lends itself less readily to enzymatic action.

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A preliminary short treatment of a film with a cultural liquid reduces considerably the time required for the subsequent washing away of the emulsion with hot water, which is of special importance when it becomes necessary to regenerate hardened, emulsified films. By customary treatment, an emulsion of such films can be taken off with hot water within 2 hours. A preliminary 6-minute submersion of the films in a cultural liquid reduces the time required to wash off an emulsion to 15 minutes. By the old [method] of perforated cutting, an emulsion was usually taken off within 24-36 hours, yet by using a much diluted cultural liquid (0.04-0.02%) it can be done within 3-4 hours.

Thus, a cultural liquid is a sufficiently effective means in the very difficult process of the regeneration of films, in the removal of sub-layer gelatin, and, in addition, in decreasing considerably the time required for washing away a photographic emulsion. The data of laboratory experiments were confirmed by large-scale tests conducted at the regeneration shops of the factory.

At present, the factory has undertaken to build a microbiological installation for the production of bacterial proteases.

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Trans. A-876
(In full)
vg/A

Nezgovorova, L. A.

Vliianie azotnogo pitaniia rastenii na temnovuiu fiksatsiiu CO_2 list'iami.

[Influence of nitrogen nutrition of plants upon the CO_2 fixation by leaves in the dark].

Fiziologiia Rastenii, vol. 3, no. 4. pp.343-351
July/Aug. 1956. 450 F58

(In Russian)

In speaking of carbon dioxide that has been fixed in the dark, we have in mind only that part of it which is fixed by a leaf in an organically bound form. The investigation of this process in photosynthesizing organisms has a history [1], but its importance to the procedure of physiological processes in plants has not by far been clarified. The capacity of plants to fix carbon dioxide in the dark has been established not only for leaves, but also for the roots of plants, and has been demonstrated by means of supplementary feeding with tagged carbonate [2,3] for fruit as well [4,5].

Interest in the process of carbon dioxide gas fixation by plants in the dark is explained by the connection established between this process and the process of photosynthesis. The primary CO_2 fixation in photosynthesis is not a photochemical reaction, but a reaction of darkness. 876

In investigating the dynamics of fixation in the dark, it was found that this process might depend on two factors. One of them determines the curve that rises slowly at the right time reflecting enzyme fixation of carbon dioxide gas, which is analogous to the fixation observed in animals tissues. The second factor determines the curve of the absorption of carbon

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dioxide gas in the dark that rises more intensively during the first few seconds, appears only after preliminary illumination, and is connected with the formation of reducing agents when exposed to light. [6]. The influence of preliminary lighting upon CO_2 fixation in the dark was observed in working with whole leaves, as well as with a suspension of the crushed leaves of higher plants [7,8]. It appears to us that preliminary lighting exerts a particularly strong influence upon CO_2 fixation in darkness in those objects in which an outflow is absent, for instance, algae, disjointed leaves and their suspensions. This is substantiated by data according to which increased intensity of CO_2 fixation by plant leaves in the dark is influenced not merely by preliminary exposure of a leaf to light, but by exposing it to light after it has been separated from the plant. This, probably, is connected with the accumulation of substances that perform the functions of CO_2 acceptors which flow from leaves that have not been separated from the plant by a continuous runoff [9].

Different researchers hold divergent views concerning the nature of products of plant fixation that has occurred in the dark. Some of them consider that, with regard to chemism, these products are closely related to those fixed in light and they find the basic difference between light and darkness in the intensity of the processes [10-13]. Others find sharply distinct properties of the products that have formed in the process of CO_2 absorption in darkness or in light. Data according to which there is a great disparity between the properties of fixation products brought about in darkness and those of the products that have formed during brief exposures to light, lead the researchers to believe that there is no plausibility in the theory that fixation in darkness precedes photosynthesis [14]. Doubts concerning the need of control over darkness in a study of the primary products of

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photosynthesis occur in our native literature as well [13].

Our observations of the dynamics of CO_2 fixation by bean leaves have indicated [Begin p.344] that the differences between CO_2 fixation in the dark and its assimilation in light decrease, as exposure to and intensity of light are decreased. The later [CO_2 assimilation in light] is determined not only by the intensity of the processes, but also by the fractional distribution of fixed carbon dioxide. Thus, it was found that in a 5-second exposure, CO_2 fixation by bean leaves in darkness amounted to 89.6% of its absorption in weak light, and to 53.8% of its absorption in bright light. As exposure increases, the gap in intensity between these processes increases accordingly, and in an exposure of more than 20 minutes fixation in the dark amounts to 7.7% of fixation in weak light. As far as fractional distribution of carbon dioxide is concerned, similar products that have formed in the dark and in daylight in 5-second exposures, manifest a sharp difference after 2-3 minutes. These observations permit the assertion that in investigating the first products of photosynthesis under conditions of brief exposures and an increased CO_2 content in the air, it is necessary to establish control over the intensity of fixation in darkness and its products [10]. However, an interpretation of data obtained even under darkness control is rendered difficult by the fact that up to now it has been impossible to separate decisively fixation in darkness that has a direct relation to photosynthesis from the fixation that is analogous to the one observed in heterotrophic organisms and animal tissues.

The presence of the general reactions of CO_2 fixation by plant roots [2,3] and liver sections [15-17] excite no doubt as to those that take place in CO_2 fixation in the dark by photosynthesizing plant organs. According to contemporary concepts fixation in the dark can be accomplished

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by adding CO_2 to pyroracemic acid or to a-ketoglutaric acid. Reduction amination of acids that form in the process is accompanied by a synthesis of amino-acids and thus, with the assistance of the di- and tricarbonate acid cycle, the carbon dioxide fixed in the dark is incorporated in plant metabolism. The formation of organic acids in the process of heterotrophic fixation of CO_2 has been demonstrated convincingly in a number of works [18, 19], but similar observations are known primarily for plants of the succulent type which are distinguished by unique biochemical physiological characteristics and by dynamics of organic acids. The formation of organic and amino acids in the fixation of tagged carbon dioxides in the dark has been indicated for algae [20], roots [2,3], fruit [4,5] and leaves [18, 19]. Nonetheless, despite the common nature of many links of biochemical processes occurring in all biological objects, the presence of special reactions connected directly with the photosynthetic process is not excluded. American researchers consider that the CO_2 acceptor in the photosynthesis process is ribulosediphosphate [21].

In interpreting our early data [9, 10, 22, 23], we proceeded from the concepts developed by Levshin [24, 25] and Sapozhnikov [26] concerning the primary chloroplast protein synthesis and the possible role of protein radicals as the first acceptors of carbon dioxide gas in the process of photosynthesis [27].

In continuing the work along these lines, we obtained material that has enabled us to speak of the important role played by aminoacids in the fixation of protein molecule linkages in the dark. The problem concerning the role of protein substances remains unsolved because in analyzing material fixed by boiling in which many chemical bonds are distrubed, it is difficult to say whether aminoacids participate in this process in vivo in a free state

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or bound with proteins. It is probable that proteins, too, take part in the biochemical functions of an organism in a restricted state (with 16% of nitrogen), but in conjunction with a whole series of other compounds (due to which the content of protein nitrogen is considerably decreased).

In connection with the notion that there was a possible primary bond between carbon dioxide gas and protein in the carbon assimilation process, it appeared interesting to investigate how the actions that influence the protein content in leaves will effect CO_2 fixation that takes place in the dark. [Begin p.345] One of the factors that change protein content is nitrogen nutrition which we utilized in our experiments. Since it was found in a series of investigations that the first stable products of photosynthesis are phosphorylated compounds and that reactions connected with phosphorylation in general are attributed great importance in photosynthetic reactions [21, 28, 29] in the dark and in light, we included in the scheme used in some of our experiments the investigation of the influence exerted by phosphorus nutrition upon CO_2 fixation by leaves in the dark. In doing the work, we undertook to trace not only the intensity of the process of CO_2 fixation in darkness, but also the compounds into which the fixed carbon flowed.

PREPARATION OF EXPERIMENTAL PLANTS

The experimental plants were tobacco, sunflowers, cucumbers and beans. Tobacco in the phase of 4-5 leaflets was transplanted from seedling boxes into [Eilhard A] Mitscherlich's [Mitcherlikh] vegetative containers that were filled with quartz sand and the nutritive mixture of [Hermann] Hellriegel [Gel'rigel] - (NPK). In the course of 4 days the amount of nitrogen in some of the containers was increased up to three norms by

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by means of supplementary feeding with calcium nitrate. Thus we had two variations of plants, with NPK and 3N(PK). When the plants proceeded to develop the 16th leaf, those in the containers that had one norm of nitrogen lagged visibly in growth and had more of a pale green color compared to those that grew on a 3N(PK) background. The external differences between these plants can be seen on fig. 1.

One group of the plants grown on one norm of nitrogen for 56 hours was fed supplementary nitrogen in three intakes up to three norms; the second group was fed phosphorus up to three norms; the third was left without supplementary feeding. Simultaneously, a group of plants grown from the beginning of the experiment on three norms of nitrogen received, in the same manner, supplementary feeding of phosphorus. Thus, the plants used in the experiments conducted for an investigation of CO_2 fixation in darkness were as follows: 1) those grown on Hellriegel's mixture (NPK), controls; 2) those grown on a NPK background, but fed supplementary nitrogen food (NPK + 2N); 3) those grown on an NPK background and given supplementary phosphorus food (NPK + 2P); 4) grown on a 3N(PK) background and given supplementary phosphorus food [3N(PK) + 2P].

In the time period from the first until the third supplementary nitrogen feeding, the plants which heretofore had felt its deficiency turned dark green and accelerated their growth processes which were inspected by measuring the height of the plants and the leaf area [ploshchad']. The change in the protein content in leaves brought about by supplementary feeding of nitrogen was judged by establishing nitrogen in general and protein nitrogen which was determined by the Kjeldahl [K'el'dal'] micromethod used in sedimentation of proteins according to Barnstein [Barnshtein]. The 14th leaf, counting from the bottom, was used to determine nitrogen, as well as in all experiments.

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Fig. 1. Tobacco plants growing on one (1, 2) and on three (3, 4) norms of nitrogen

Data concerning the influence of various nutritive conditions upon the content of general and protein nitrogen in plant leaves are cited in table 1.

It is apparent from the data in table 1 that in plants which were fed nitrogen supplementarily, as compared with controls that had experienced its deficiency, the content of general and protein nitrogen had increased heavily in calculations of the absolutely dry weight as well as by the unit of the leaf surface. The fact that the difference between general and protein nitrogen is very small enables one to speak of the high synthetic activity of leaves and of the rapid inclusion of mineral nitrogen into synthetic processes. Plants grown on good nitrogen nutrition or that were fed nitrogen supplementarily contained 3-4 times more free aminoacids than plants that grew up under nitrogen deficiency. [Begin p.346].

Supplementary feeding of phosphorus was not reflected in the content of protein nitrogen within leaves, but this does not justify a negation of the role played by phosphorus in these processes, one can merely say that control plants experienced no deficiency of phosphorus nutrition which inhibits biochemical processes. The first series of experiments with tobacco leaves was conducted with young plants in the phase of 15-16 leaves, the second series - with the 14th leaf taken from flowering plants, and the second time only two plant variations were used, controls (NPK) and plants that had been given supplementary nitrogen food during the 66 hours preceding the experiment (NPK+2N).

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Table 1.

Influence of the differences in plant nutrition upon the content of protein nitrogen and general nitrogen in tobacco leaves

Conditions of plant growing (background)	Nitrogen in %		Protein nitrogen in mg per 100 cm² of a leaf
	Protein	General	
NPK - controls	1.93	1.89	9.55
NPK ≠ additional 2N	3.38	4.03	12.34
NPK ≠ additional 2P	1.78	1.96	7.86
3N(PK)	3.81	4.20	13.97
3N(PK) ≠ additional 2P	3.37	4.13	12.48

Other experimental plants - sunflowers, cucumbers and beans - were grown in boxes with quartz sand and Hellriegel's nutritive mixture, in one case without nitrogen and in another with three norms of nitrogen. The sunflowers and cucumbers were grown in natural light in a nursery, the beans - under luminescent lamps with a white luminophorex, at an 80% humidity of the total moisture.

The leaves used in the experiment were taken from two-week old plants which experienced the deficiency of nitrogen not included in their diet. The content of protein nitrogen in plants grown without nitrogen was considerably lower than in plants reared on a nitrogen background.

To determine CO_2 fixation in tobacco leaves that had occurred in the dark, the experimental leaf was cut off the plant, yet the leaves of young sunflower, cucumber and bean plants were exposed to $C^{14}O_2$ in a chamber without being cut off the plant. The experiments were conducted in a chamber with a 3% CO_2 content including 1% of tagged carbon.

METHODS FOR CHEMICAL ANALYSIS

To determine the intensity of fixation in darkness of CO_2 and the content of fixed carbon in carbohydrates and aminoacids, the leaves, fole

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lowing exposure, were fixed with an 80% ethyl alcohol and thoroughly pulverized, and the homogenate was transferred onto a paper filter on which the material was washed with hot alcohol until the green pigments were fully extracted. The alcohol extract obtained was washed with benzene (fraction up to 100°) and concentrated in a water bath. The total intensity of CO_2 fixation was determined directly in the concentrated alcohol fraction with the aid of the end-window counter. To determine the C^{14} content in the aminoacids of an alcohol fraction, the aminoacids had to be separated from the carbohydrates. They were divided by the chromatographic method on paper in an 85% ethyl alcohol with a downward flow of the solvent. In so doing the carbohydrates descended after 21-23 hours and the basic bulk of aminoacids was distributed in the upper portion of the chromatograph. After the appearance of the "markers [metchikov]" the chromatograph was cut 2 cm above the place where the carbohydrates were situated, and both parts of it, containing aminoacids and carbohydrates, were eluated [eliuirovalis'] separately by water and by 80% ethanol. The eluated material was concentrated in a water bath and chromatographed in a mixture of n-butyl alcohol, formic acid and water (18-2-9) with subsequent manifestation.

To determine the content of C^{14} in organic acids, the material, after exposure to $C^{14}O_2$ was fixed in a drying cabinet at 100°, pulverized and extracted in a Soxhlet apparatus with sulfuric ether acidified with hydrochloric acid in the course of 80 hours. After the removal of the ether the remainder was dissolved in water and transferred onto a glass [slide] so as to determine the specific activity on the end-window counter. Organic acids were determined qualitatively by the method of chromatographic division on paper in the same mixture that was used in the division of aminoacids.

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In the identification of compounds in which C^{14} fixation occurred, radioautographs were obtained from the chromatographs. The quantity of C^{14}, however, in individual, identified compounds was determined either by a direct count of the impulses on the chromatograph in accordance with radioautograph spots, or, in the event of a small C^{14} content, by a count of impulses of the substance eluted from the chromatograph in accordance with its spot on the radioautograph. [Begin p.347].

EXPERIMENTAL RESULTS

In a study of the products of CO^2 fixation in the dark it became clear that it was common for all investigated plants that, within the limits of a 30-minute exposure of leaves in a cabinet to $C^{14}O_2$ in the dark, a passage of tagged carbon into carbohydrates was not observed.

Table 2.

Distribution of C^{14} fixed in the dark in tobacco leaves

No. of variation	Conditions of plant growing	Total fixed	Extracted with ether	Organic acids (in %)	Amino-acids (in %)
		in 1000 impulses per 100 cm^2			
1	July 23. Plants in phase of 15-16 leaves				
1	NPK	3.93	1.41	35.7	64.3
2	NPK+2N (Additional feeding)	9.07	2.48	27.3	72.7
3	NPK+2P (Additional feeding)	2.90	1.29	44.3	55.7
4	3NPK	8.80	3.12	35.4	64.6
5	+2P Additional feeding	9.78	2.86	26.1	73.9
	August 25. Flowering Plants				
6	NPK	1.48	0.96	65.3	34.7
7	NPN+2N (Additional feeding)	3.95	1.78	45.1	54.9

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Data concerning the passage of carbon fixed in the dark into amino acids and organic acids are cited in table 2. Leaves of the Silvestris tobacco variety were analyzed after a 30 minute exposure to $C^{14}O_2$. If we disregarded the C^{14} content found in the residue after the extraction of the alcohol fraction which equals parts of a percent [10], then all carbon fixed in the dark in tobacco leaves would be distributed among aminoacids and organic acids. Data in table 2 indicate also that plants grown on a superior nitrogen background (variation IV) fix in the dark twice as much CO_2 as plants grown under nitrogen deficiency (variantion I). Feeding additional nitrogen to plants that have experienced its deficiency (var. I) doubles fixation intensity in the dark (var. II). The leaves of young plants that have not completed their growth (var. I) fix almost twice as much CO_2 as leaves that have finished growing and are taken from plants in bloom (var. VI). However, leaves of plants in bloom also react to supplementary nitrogen feeding by increasing the intensity of fixation in the dark (var. VII). Nitrogen feeding changes not only the over-all intensity of CO_2 fixation in the dark, but the character of the distribution of carbon fixation as well. Cultivation of plants on good nitrogen food, as well as supplementary nitrogen feeding of plants is accompanied by an accelerated passage of tagged carbon fixed in the dark in a larger measure into aminoacids than into organic acids.

In young plants on a NPK background the over-all fixation was expressed in 3.93 thousand impulses (see table 2); after supplementary nitrogen feeding it equalled 9.07 thousand impulses, i.e. by 5.14 thousand more. Of the 5.14 thousand only 1/5 share of the impulses pertained to organic acids, the other 4/5 went to the aminoacid share. These data

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justify the thought that an abundance of nitrogen in plant nutrition favors growth processes and protein synthesis in leaves, it exerts influence upon the intensity of CO_2 fixation in the dark and facilitates the passage of carbon into aminoacids. As regards the composition of substances in which carbon is fixed in the leaves of cucumbers and sunflowers, it can be judged [Begin p.348] by the radioautographs (fig. 2, A, V, G) that were obtained vfrom the chromograph of an alcohol fraction after carbohydrates had been removed from it (fig. 2, B). Leaves were exposed to $C^{14}O_2$ in the dark for 20 minutes. It can be seen on the radioautograph that in plants with better nitrogen nutrition (var. 2 and 4) passage of tagged carbon was more intensive than in plants that had experienced nitrogen deficiency (var. I and III). The largest quantity of tagged carbon is contained in aspartic and malic acids. Besides aspartic acid, aminoacids that are tagged include lysine, arginine, alanine, glycocoll and glutaminic acid. The quantitative distribution of C^{14} among aminoacids and organic acids can be seen from data in table 3 which were obtained by means of densitometric measuring of spot activity on the chromatograph directly beneath the end-window counter.

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Table 8.

Distribution of C^{14} fixed in cucumber and sunflower leaves in the dark

Fixation	Cucumbers		Sunflowers	
	PK	SN(PK)	PK	SN(PK)
Number of impulses				
Total	2106	2401*	1386	2792
In aminoacids	1102	1698	721	1920
Including those in aspartic acid	602	1047	356	1326
In organic acids	1003	803	665	872
Including those in malic acid	917	725	635	713
Percentages				
Total	100	100	100	100
In aminoacids	53	71	49	69
In organic acids	47	29	49	51
In aminoacids	100	100	100	100
In aspartic acid	65	61	49	69
In organic acids	100	100	100	100
In malic acid	95	90	95	82

*[Should be 2501]

Data in table 8 indicate that in the leaves of young cucumber and sunflower plants that have experienced nitrogen deficiency, carbon fixed in the dark is divided about evenly between organic acids and aminoacids. In addition, half of the carbon contained in aminoacids is included in aspartic acid, and in organic acids 90% is fixed in malic acid, and only 10% in succinic and fumaric acids. In the leaves of cucumbers and sunflowers reared with good nitrogen nutrition that is accompanied by an increased protein content, the intensity of CO_2 fixation in the dark is increased, as a result of which in this case, as well as in the case of tobacco leaves, carbon fixation in aminoacids grows.

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The radicautograph (fig. 2, D) shows the distribution of carbon of an alcohol fraction in bean leaves after they had been exposed to $C^{14}O_2$ in the dark for 5 seconds, 5 minutes and 20 minutes. According to the protein nitrogen content, leaves of plants reared on a background of NPK and 2N(PK) [Begin p.349] differed by 27% (in controls the nitrogen percentage was 2.98, in nitrogenous - 3.78). With respect to the over-all C^{14} fixation it was found that in a 20 minute exposure the leaves of plants with a good nitrogen nutrition fixed 35% more CO_2 than control plants. In beans carbon fixed in the dark is distributed basically among aspartic and malic acids. At a 5 second exposure the first aminoacid to be tagged is aspartic acid, and the first organic acid is malic acid. When the duration of exposure is increased C^{14} accumulates in the aspartic and malic acids, but parallel [with these] a whole series of other aminoacids, such as alanine, lysine, arginine, asparagine and glutamine acid, are also tagged.

Data on the quantitative distribution of C^{14} among amino and organic acids are cited in table 4.

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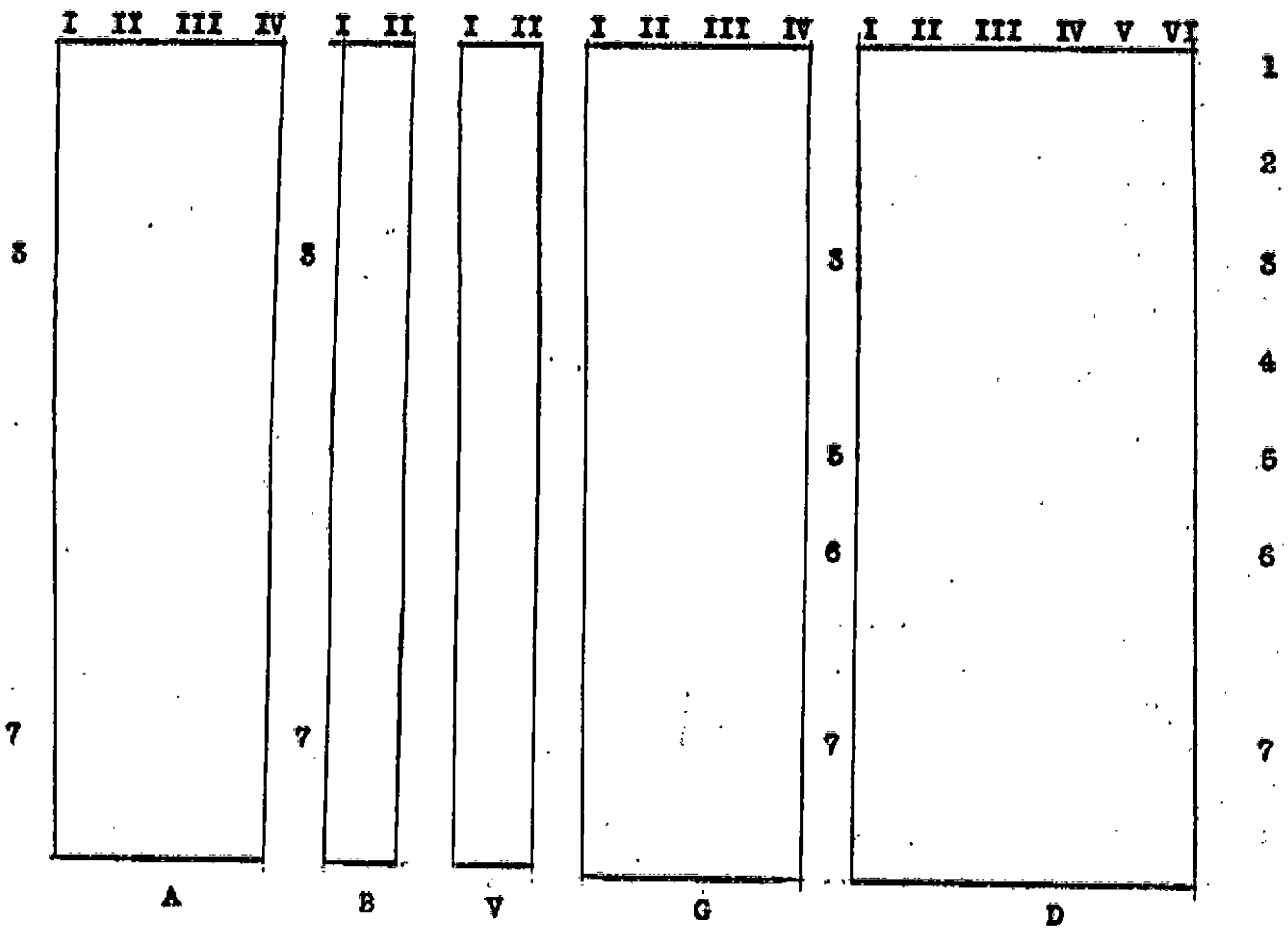

Fig. 2. Radioautographs (A, V. G,) - cucumbers and sunflowers; D - beans B chromatograph of aminoacids.

A - radioautograph of chromatograph after a 24-hour separation developed 4 days later;

G - Same, developed 17 days later; V - radioautograph of chromatograph after a 72-hour separation, developed 28 days later; B - chromatograph of aminoacids, developed by ninhydrin.

I and II - cucumbers, III and IV - sunflowers; I and III - without nitrogen; II and IV - with nitrogen.

D - radioautograph after 24 hours of separation, developed 30 days later; I, II, III - without nitrogen, IV, V, VI - with nitrogen; I and IV exposure for 5 seconds, II and V - 5 minutes, III and VI - 20 minutes. 1 - lysine; 2 - arginine and asparagine; 3 - aspartic acid; 4 -- glycocoll; 5 - glutamine acid; 6 - alanine; 7 - malic acid.

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Table 4.

Distribution of C^{14} fixed in the dark in bean leaves (thousand impulses per 100 cm^2 of leaf surface)

Group of substances	PK			2N(PK)		
	5 sec.	5 min.	20 min.	5 sec.	5 min.	20 min.
In aminoacids (primarily aspartic)	0.17	0.41	1.68	0.31	1.86	3.27
In organic acids (primarily malic)	0.18	0.38	1.81	0.19	0.39	1.79

Data in table 4 indicate that nitrogen nutrition practically did not change the passage of tagged carbon into organic acids, yet it increases considerably the passage of tagged carbon into the composition of aminoacids.

DISCUSSION OF RESULTS

The passage of tagged carbon, in the process of CO^2 fixation in the dark, into organic acids can be represented by means of adding carboxyl to a-ketoacids with its subsequent reduction and inclusion into the di- and tricarboxylic acid cycle. The presence of tagged carbon in aminoacids can be explained by the reducing amination of carboxylic a-ketoacid. Thus, amination follows after tagged carbon has been fixed in carboxyl. Since aspartic acid is the first aminoacid to be tagged, there can scarcely be any doubt that the other aminoacids are likely to form when aspartic acid is included in reamination reactions. We have no doubt as to these possibilities, and our results obtained from nitrogen influence upon the distribution of carbon fixed in the dark can be explained by amination of ketoacids with tagged carboxyl. However, in recognizing this possibility, it must be noted that the means of aminoacid synthesis in plant leaves have not been studied exhaustively and existing concepts are based for the most part

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on analogies observed in the investigation of metabolism in microorganisms and animal tissues.

In analyzing our results we do not exclude the possibility that, in CO_2 fixation in the dark, there are other means of carbon entry onto compounds that have a relation to subsequent light reactions in photosynthesis. For if the formation of all aminoacids were connected simply with the products of carbohydrate oxidation by means of carboxylation or direct amination of pyroracemic acid which has been demonstrated for plants, then a portion of mineral nitrogen would contribute toward the formation of alanine, but not of aspartic acid. In our data half of the carbon fixed in the dark [Begin p.560] is found in organic acids, while the number of organic acids tagged in the dark is very small and 90% of their carbon is contained in malic acid. The other half of the carbon fixed in the dark is found in aminoacids, primarily in aspartic acid.

If it were imagined that the formation of malic and aspartic acids occurred by means of carboxylation of pyroracemic acid, then a supplementary feeding of nitrogen with a possible direct amination of pyroracemic acid [30], and an increased intensity of the process of C^{14} entry into aminoacids, should correspondingly decrease the inflow of C^{14} into malic acid. Meanwhile, we have observed nothing of the kind. On the basis of this it can be assumed that C^{14} fixation in malic acid differs from that of C^{14} in aspartic acid. The first, apparently, belongs to the type of CO_2 fixation found for the roots of plants, animal tissues, microorganisms and succulent plants, and the other is possibly, involved in photosynthesis and is connected with carboxylated functional protein groups arranged in side chains.

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Thus, it appears to us that carboxylation does not precede amination, but the substance that already contains the amino group becomes carboxylised. In such a case, the photosynthetic transformation of carbon must be connected with free, or bound aminoacids, while aspartic acid must be of great importance among them. There can scarcely be any doubt as to the great importance of dicarbon aminoacids in metabolism, and aspartic acid can be presented as an intermediate link in the photosynthetic process, since it combines successfully the capacity to transport carbon as well as the NH_2-group which puts it in the center of the oxidation-reduction conversions. The thought that carbon is bound with parts of the protein complexity in the dark stage of photosynthesis fits fully into the framework of concepts being developed at the Photosynthetic Laboratory of the Institute of Plant Physiology im. K. A. Timitiazev, Academy of Sciences USSR, according to which the synthesis of the proteins themselves is connected with the photosynthetic process [31, 32].

Until of late, it was customary in schemes of the respiratory oxidation process to proceed from the principle that carbohydrates are respiratory material. However, data available in literature answer in the affirmative the question as to the possibility of utilizing proteins also as respiratory material [33-35].

On the basis of the above statements we would like to examine our results in connection with protein and not with carbohydrate metabolism, i.e. hypothesize that the primary CO_2 fixation in the dark, and, probably, also its fixation in photosynthesis are realized on the products of protein metabolism and not on carbohydrate metabolism. There are facts for such a possibility, for example, the amino groups of proteins found in the lateral branches of the peptide chain are capable of interaction with many com-

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pounds, including carboxyl. Besides, there are data concerning the inclusion of aminoacids and dipeptides into the proteins of isolated chloroplasts [36], data concerning the heterodynamics of peptide relations in proteins [37], on the possibility of replacing one aminoacid with another [38], which justifies the opinion that all of this is a moment on the process of self-regeneration of a protein the synthesis of which is connected with the photosynthetic process.

CONCLUSIONS

1. Supplementary feeding of nitrogen to plants which heretofore have experienced its deficiency is accompanied by an increase in the intensity of CO_2 fixation in the dark, chiefly in aminoacids, parallel with an increase in the protein content in leaves.

2. The first and more actively tagged aminoacid during fixation in darkness is aspartic acid. Carbon fixed in the dark is discovered within 20 minutes also in alanine, serine, glycocoll, glutaminic acid, threonine, asparagine, lysine and arginine.

3. The first of organic acids to be tagged is malic acid which contains almost all of the carbon found in organic acids.

4. The carbon fixed by plant leaves in the dark is not found in carbohydrates, but is distributed among amino and organic acids.

5. There is a hypothesis that the process of CO_2 fixation by leaves in the dark which relates to photosynthesis is connected with aminoacids, and in the process of CO_2 fixation in the dark which precedes photosynthesis, it is not amination that follows carboxylation, but on the contrary, the product that is being carboxylated has already been aminated.

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I wish to express my gratitude to the Director of the Laboratory of Photosynthesis, Professor A. A. Nichiporovich, for his advice in carrying out and arranging this work.

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Dec. 25, 1955

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Dunin, M. S. (Reviewer)

Bolezni rastenii*

Plant diseases, the yearbook of agriculture, 1953. Washington. The United States Government Printing Office. 940p.

Zashchita Rastenii ot Vreditelei i Boleznei
vol. 2, no. 2, p.60. Mar.-Apr. 1957. 421 Z1

(In Russian)

In contrast to the practice of previous years, the Department of Agriculture, USA, has changed drastically the structure of its "Yearbooks".

In past years they contained mosaically bright material concerning novelties of science and practice in plant and animal selection, in agrotechnics, amelioration, soil science, mechanization, zoo-techniques, agricultural economics, exports, imports of agricultural products, plant quarantine etc. Since the year 1936 the "Yearbooks" have been organized on a different principle: each volume has been devoted to a separate important branch of science and practice.

The voluminous book entitled "Yearbook for 1953" consists of 13 main sections devoted to general problems of phytopathology, immunity of plants to diseases, general survey of chemical, quarantine and other methods for the control of plant diseases, diseases of cereals and grass, legumes, cotton, ear grain crops and maize, vegetable, fruit, sugarbearing, ornamental, nut and other crops. 877

Articles on plant diseases that develop after the harvest, during transportation and storage are arranged in special sections. A detailed

* The translation of this book was published by the State Publishers of foreign literature.

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subject index is given at the end. The book is illustrated with 32 plates of colored photographs showing examples of fungus, bacterial, and virus diseases, noninfectious diseases and helminthosis of plants.

The book was compiled with the assistance of a number of famous American phytopathologists, mycologists, immunologists, virologists and representatives of other specialties: (Stakman, Christensen, Doolittle, Bennet, Dreitlow, Keitt, Wingard, Coons and many others).

The large staff of authors and variety of problems are responsible for the considerable diversity of the scientific level of statements, varied construction and style of the articles. Some articles outline partly known and also partly new, essentially important results of investigations of variability and structure of phytopathogenic organisms, of plant immunity to diseases, use of new fungicides and other chemical means and so forth. At the same time, other articles scarcely go beyond the limits of elementary information concerning the properties of some causal agents of diseases and methods of identifying phytopathogenic fungi.

Such relatively unimportant material, however, occupies very little space in this voluminous book. On the whole the book presents material of considerable interest not only to phytopathologists, but also to plant growers, plant breeders, chemists, toxicologists, workers in plant quarantine organizations, microbiologists, mycologists, fruit growers and specialists in the growing of ornamental plants. The book will also interest workers in other specialties connected in one way or another with the cultivation of food and fiber crops, medicinal and other crops, and with the transportation, storage, and processing of various plant industry products.

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Neklesova, I. D.

Fosfororganicheskie insektitsidy.

[Phosphoro-organic insecticides].

Priroda, no. 4, pp.27-33,
1957. 410 P933

(In Russian)

Shortly before World War II, there were discovered some remarkable properties in certain organic phosphorus compounds. It proved that many of them could be used successfully in the control of crop pests, i.e. utilized as insecticidal preparations.

Insecticidal properties of phosphoro-organic compounds were first discovered in Germany by G. Kuekenthal in the laboratory of G. Schrader. They are distinguished favorably from other poisonous chemicals by their speedy action upon insects and by their great universal adaptability. Phosphoro-organic compounds replace successfully expensive insecticides of plant origin such as anabasine and nicotine.

When treated with very small amounts of phosphoro-organic insecticides, most insects become irreversibly paralyzed within a short time and are barely able to move. Tests have been conducted with a large quantity of organic derivatives of phosphoric, thiophosphoric, pyrophosphoric, thiopyrophosphoric and phosphinic acids. It appeared that many of them, which possessed strong insecticidal action, were simultaneously highly toxic for man and domestic animals and, therefore, unfit for practical purposes. However, from a large number of synthesized phosphoro-organic compounds there were, found such that could be utilized effectively in agricultural practice.

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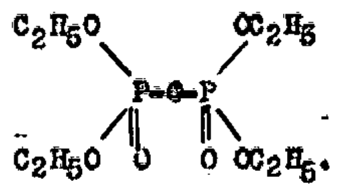
By the action which phosphoro-organic insecticides exert, they can be divided into contact, stomach and "systemic" types. Contact and stomach insecticides kill pests when they land directly either on their integuments or into their stomach together with food. "Systemic", or chemotherapeutic, insecticides which penetrate into the plant through the leaves or roots spread throughout the vascular system and impart to it toxic properties. Plants treated with such compounds are for several weeks toxic for insects that feed on them.

Ethyl ester of pyrophosphoric acid - tetraethylpyrophosphate (TEPP) can be considered as one of the first phosphoro-organic insecticides of contact-stomach action that is used widely in agricultural practice,



This compound was first obtained in pure form by A. E. and B. A. Arbuzov back in 1931. The insecticidal properties of tetraethylpyrophosphate were discovered considerably later (in 1938). It is extraordinarily effective against [Begin p.28] various types of pests. Paralysis of insects sets in 15-20 minutes after water solution of TEPP in 0.001-0.01% concentrations have dropped on them. The quick action of the preparation excludes a transfer of the insects to neighboring plots. TEPP is the basic active element of Bladan - the insecticidal preparation known abroad.

However, along with its high toxicity for injurious insects, it was discovered that TEPP possessed high toxicity for warm-blooded animals which makes working with it dangerous. As a result, it found no practical application as an insecticidal preparation in the Soviet Union. But a large number of new insecticides was obtained on its base. Scientists were

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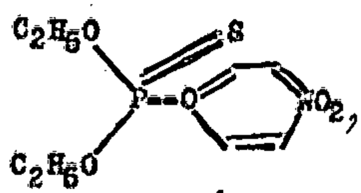
eager to obtain an ideal insecticidal preparation which, while possessing high effectiveness in the control of a large number of species of crop pests, would simultaneously be non-toxic or mildly toxic for warm-blooded animals and, in addition, would not injure plants. Preparations were produced with contact-stomach action, such as thiophos, or NIUIF-100 (known abroad under the names of parathion and E605, pyrophos, dithiophos, carbophos, or malaton).

Thiophos, diethylparanitrophenylthiophosphate,



was synthesized in Germany by G. Schrader, in the Soviet Union - in the laboratory of Prof. N. N. Mel'nikov of the Scientific Institute for Fertilizers and Insectofungicides im. Prof. Ia. V. Samoilov (NIUIF).

The preparation NIUIF-100 is released by industry in the form of a technical product representing a dark-brown liquid with an unpleasant odor. It is being used in the form of emulsions and dusts. Water solutions of the preparation are not very stable. It possesses an extremely wide range of action. Insignificant amounts of it kill various species of sucking, gnawing insects and ticks (effective concentrations are 0.002-0.2%).

Various aphids (apple, bean, wormwood, current etc) perish completely within a day when plants are sprayed with 0.002-0.005% solutions of the preparation. Thiophos is effective also against grape and oak phylloxera, and against dangerous pests of subtropical crops (mealybugs, citrus Pulvinaria, tea moth [Parametriates sp.]) for which no control measures had been developed prior to the use of thiophos, regardless of the great damage which these pests caused.

Moist disinfestation [dezinsektsiia] with 0.008% thiophos emulsion

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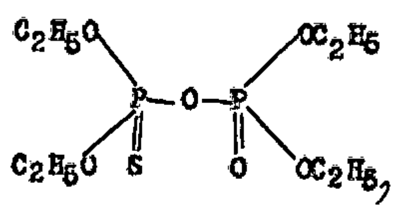
disinfests granaries from storage pests that damage grain, flour, bread and biscuits (rice and granary weevils, the small and large mealworm, pea weevil).

Thiophos is highly toxic in the control of plant eating mites injurious to citrus crops, cotton, raspberries, garden strawberries, currant, plums, pears, grapes, cucumbers (the red citrus mite and spider mite). Mite mortality within 1-2 days is 99-100%, but the results are not steady: in a number of cases mites again invaded the plants after 10 days. This is due to the fact that thiophos does not kill mite eggs and is active only 3-4 days. The mites that emerge from the eggs multiply very rapidly and since thiophos concomitantly kills the natural enemies of mites, treatment with it results, in a number of cases, in an increase of mites, despite the high toxicity that thiophos has for the pest. In addition to thiophos, a large number of its homologues were synthesized and investigated. Among them potasan (diethyl-4-methyl-7-oxycoumarilthiophosphate, E838) was discovered - a preparation with selective toxicity for the Colorado beetle. This preparation exerts toxic action upon aphids, caterpillars and other insects only in high concentrations, while it causes the complete destruction of the Colorado potato beetle within 3 hours after the plant has been treated with 0.1% solution of this preparation.

Pyrophos, tetraethylmonothiopyrophosphate,



[Begin p. 29] was obtained in Kazan in 1931 by A. E. and B. A. Arbuzov. By using their reaction, G. Schrader obtained tetraethyldithiopyrophos-

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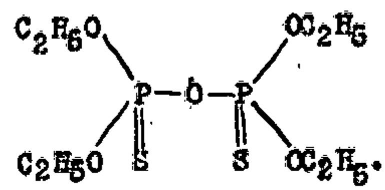
phate (dithiophos).



It proved that by replacing the oxygen atom in the TEPP molecule with the sulfur (pyrophos) atom the toxicity for warm-blooded animals is decreased, and the introduction of the second atom of sulfur (dithiophos) reduces the toxicity of the preparation even more without impairing its insecticidal properties.

Technical pyrophos is a dark-brown liquid with an unpleasant odor, very slightly soluble in water. The water solutions are hydrolyzed rapidly and the toxic solutions lose their effectiveness within a day [24 hrs]. Pyrophos is applied in the form of water emulsions. In the Soviet Union it was tested extensively by scientific-research institutes. It was established by means of these tests that the poison exerted a strong contact and stomach action upon a large number of pest types: various aphids, citrus Pulvinaria, pear psylla, Urygaster integriceps, scale insects [Diaspedidae], scale insects [Pseudococci], beetles, caterpillars, flies, ticks [or mites], grape Phylloxera, and mosquitos. Destruction (98-100%) of small pests - aphids, Psillids, and mites results from pyrophos solutions in 0.005-0.01% concentrations. Concentrations of 0.05-0.1% were effective against larger insects - beetles, mealybugs, bed bugs or scale insects well protected by their coat.

Under laboratory conditions the pyrophos preparation produced excellent results on the Colorado potato beetle. As regards its toxicity against this most dangerous quarantine pest, it surpasses considerably the potasan preparation. Under field conditions, however, pyrophos proved in-

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sufficiently effective which, apparently, was due to the poor stability of the preparation in water solutions.

It can be expected that dithiophos will produce a good effect under field conditions as well, since its water emulsions have considerably more stability and its toxicity for insects and character of action are almost identical. This preparation will be tested extensively on various objects in the very near future.

The dithiophos technical preparation is a dark-brown liquid with an unpleasant odor. It is used in the form of water emulsions. Similar to pyrophos, it possesses a wide range of action, killing sucking as well as gnawing insects and mites - pests of agricultural crops, and also bed-bugs, flies, mosquitos, cockroaches, fresh-water mollusks and pasture ticks.

The value of the pyrophos and dithiophos preparations should be pointed out in the control of the Japanese waxy false-scale [Ceroplastes japonicus Green], the natural enemies of which have not been noted on territory of the Soviet Union. This dangerous quarantine pest of subtropical plants injures about 90 species of perennial crops, including noble laurel, tea, date plum and citrus plants.

Other phosphoro-organic compounds - thiophos, carbophos, metaphos - and chloride containing insecticides, such as DDT and benzene hexachloride [GKhTsG], are scarcely effectiven against this pest even when applied in high concentrations. When saplings of citrus plants are released from farms infested by pseudo-scale insects they must be disinfected. Fumigation of young plants with prussic acid or methyl bromide is most effective. This treatment is very work-consuming and expensive. Meanwhile, pyrophos and dithiophos can be used for the disinfection of saplings with some sucess; 96-100% destruction of pseudo-scale insects can be achieved by spraying with

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0.2-0.25% water emulsions of these preparations. Cuttings of citrus trees infested by mealybugs, scale insects, pseudo-scale insects are also completely freed from these pests when they are treated with 0.2% pyrophos and dithiophos solutions (by immersion in solution), without decreasing the growth capacity [prizhivaemost'] of the buds.

Preparations of dithiophos and pyrophos are used in veterinary medicine in the control of fresh water mollusks and pasture ticks. Mollusks serve as intermediate hosts of trematoda which lead a parasitic existence in the liver of mammals and provoke fascioliasis in agricultural animals. This disease is widely distributed among domestic animals in various geographical zones. [Begin p.30]. Outbreaks in the form of devastating epizootics have been observed periodically.

Pasture ticks are the carriers of pyroplasmoma and nuttalliosis of horses, diseases that are somewhat similar to malaria in man. The ticks attack the horses in the early spring, infect them and disable them for 23-32 days. If another infection developes in horses suffering from pyroplasmoma then they frequently die.

It must be noted that in the control of fresh water mollusks and pasture ticks pyrophos is more convenient than dithiophos since its water solutions lose their toxicity rapidly. Molluskocidal pyrophos solutions lose their toxicity completely on the fifth day and, therefore, the grazing of cattle on treated pastures must be prohibited for only a short period.

The organic laboratory of the Chemical Institute im. Academician A. E. Arbuzov, Kazan Branch, Academy of Sciences USSR, has lately developed an analogue of dithiophos - dimethyldiethyldithiopyrophosphate. This compound, having retained high insecticidal properties equalling dithiophos (tests were conducted under laboratory conditions), has proved to be 5-6 times less toxic for warm-blooded animals.

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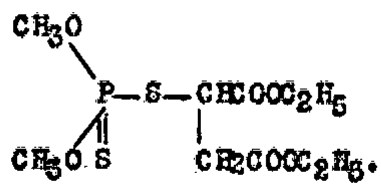
The contact-stomach poisons listed do not exert toxic action upon plants when applied in prescribed dosages, i.e. they do not burn the leaves and do not inhibit natural development. The shortcoming of these insecticides is their relatively high toxicity for man and domestic animals and, therefore, safety measures are required while working with them. Poisoning may occur as the preparations pass through the respiratory organs, the stomach and intestinal tract, and even through the uninjured skin. Lethal doses established on various types of warm-blooded animals according to data of different authors, are 0.6-2 mg for pyrophos, 4-20 mg for thiophos, and 6-40 mg for dithiophos per kg of animal weight.

In recent years NIUIF released a new phosphoro-organic preparation - carbophos (malathion):



It is mildly toxic for warm-blooded animals; its lethal doses are being calculated at the rate of 400-1400 mg/kg, i.e. it is less toxic than DDT.

This compound can be used with some success in the control of various types of aphids and mites in individual orchards. Carbophos is not, however, as universal a preparation as pyrophos and thiophos and it is non-toxic against many dangerous pests.

In the last 2-3 years there have appeared in foreign literature works about new phosphoro-organic compounds that possess highly insecticidal properties and are mildly toxic for warm-blooded animals. They are diazinon (2-isopropyl-4-methylpyrimidyl-6-diethylthiophosphate) and preparations of the Baier type (L13/59, 17147 etc.). Diazinon is lethal for warm-blooded animals at the rate 90-300 mg/kg, it belongs to the list of contact-stomach poisons.

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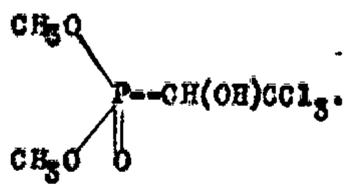
Its fumigation action is of secondary importance. In testing it against house flies, barn weevils, larvae of the mealworm and spider mites, diasinon in most cases proved as valuable as thiophos or even stronger (for instance, against mites and miller's snout moths), in addition, it kills the eggs of parasites and is 10-15 times less toxic for warm-blooded animals.

Diasinon has proved effective against soil pests, to wit, larvae of wireworms and larvae of May beetles. If a diasinon emulsion is introduced into the soil, its action is detected in the course of two months. This preparation is highly toxic against flies which are resistant to chloride containing organic insecticides (DDT). The duration of its action in sprayed rooms is estimated to be 4-6 weeks. However, complications involved in its production and its high cost make its wide-spread adoptation in practice difficult.

One of the known, more investigated preparations of the Baier type is L13/59:



This is a hard substance freely soluble in water and stable in water solutions. It is [Begin p.31] mildly toxic for warm-blooded animals (lethal doses are 225-500 mg/kg) and it is very effective against various pests of agricultural crops and "domestic" insects (flies, bed bugs, cockroaches), a 0.001% concentration causes a 100% destruction of house flies within 24 min.

Highly insecticidal properties, mild toxicity for man and simplicity of production render it a promising preparation. Compounds of a similar type have been obtained at the Kazan Branch of the Academy of Sciences USSR and at the Kazan State University im. V. I. Ul'ianov-Lenin. The initial

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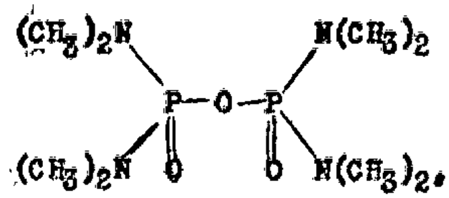
tests established their high effectiveness.

Recently, entomologists of the Soviet Union had an opportunity of conducting widespread tests of phosphoro-organic insecticdes of systemic action. The entomologists were of the unanimous opinion that these compounds are exceptionally convenient and effective in the control of many sucking pests of citrus plants, tea, the noble laurel and cotton.

Two preparations have been tested widely - octamethyl[1] (Kazan Branch of the Academy of Sciences USSR) and mercaptophos[2] (NIUIF).

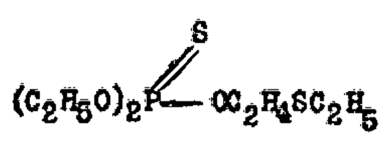
Octamethyl,



in pure form represents a colorless liquid with almost no odor, freely soluble in water, [and its] water solutions are resistant to hydrolysis. This typical systemic insecticide does not possess fumigation properties, its contact action is expressed mildly. Doses of 5-60 mg per kg of animal weight are toxic for various types of warm-blooded animals.

The mercaptophospreparation represents a mixture containing 30% of thiolic isomer (diethyloxythio-beta-ethylthiomercaptophos) and 70% of thionic isomer (diethyloxy-beta-ethylthionphosphate).

Isomers of mercaptophos:



Thionic
and

Thiolic

1 Known abroad under the name of OMPA, schradan, pestox III.
2 Known abroad under the name of systox, vnuran and demeton.

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A chemically pure compound representing a colorless liquid with a sharp, unpleasant odor, poorly soluble in water, but freely soluble in organic colvents. The preparation possesses systemic and contact action. Doses of 7-15 mg/kg are toxic for warm-blooded animals.

Recently, the mercaptophos thioanalogue, preparation M-74, was synthesized at the Institute of Elemental-Organic Compounds, Academy of Sciences USSR. This compound also possesses systemic action and is at present undergoing wide-spread testing.

Octamethyl is used in water solutions of various concentrations, mercaptophos and M-74 are used in the form of water emulsions. Polyethylene glycols (OP-7 are being used as emulsifiers).

Toxicity of plants can be achieved by various means: by plant irrigation when the systemic poison enters the plant organism through the root system, by spraying with water solutions and emulsions when the poison enters through the leaves, by preseeding soaking of seed and, finally, by wrapping the trunk of a fruit tree with fabric bandage saturated with octamethyl or mercaptophos.

It is well known that a great effect can be achieved from the use of contact insecticides only if the preparations are applied to the plant carefully. Insects which are within a plant at the lower end of the leaves are, usually, not exposed to the action of the contact poison. Treatment of plants with systemic preparations is considerably more simple, since the systemic insecticide introduced in the plant by any method spreads throughout the plant moving in both directions. As a result, it is possible to reduce the corresponding consumption rate of the liquid as compared with the rates of contact insecticides. The use of systemic insecticides [Begin p.32] makes it possible to utilize widely the most efficient method of treatment which is aircraft spraying.

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The use of the bandage method in fruit orchards not only decreases poison consumption, but it makes working with them much less dangerous for those who treat trees, since it eliminates diffusion of the preparation. The trunk of citrus, coffee and apple trees are bandaged with a fabric and saturated with a 1.5-3% octamethyl or mercaptophos solution. To prevent evaporation of the solution the bandage is wound around with a waterproof material. The insecticides are absorbed through the bark and within 14 days the trees acquire the properties that are toxic for many sucking pests. The trees treated with octamethyl remain toxic on the average for about 45 days, but sometimes their toxicity is prolonged up to three months. The duration of toxicity depends primarily on the amount of the preparation assimilated by the plant, on the plant species, and on its physiological condition.

Octamethyl and mercaptophos have been tested widely in the Soviet Union in the subtropic zone of Georgia, in Uzbekistan and Tadzhikistan. Both compounds proved exceedingly effective in the control of pests attacking lemons, mandarins, tea, persimmons, noble laurel, mulberry trees and cotton.

The principal and most dangerous cotton pests are the spider mite and melon (cotton) aphid. The spider mite is extremely prolific and is distributed all over the USSR. The development of one generation requires from 10 to 28 days, thus it is capable of producing in the South up to 16 generations per year. The mite inhabits chiefly the lower end of the leaves, it sucks them out and weaves the most delicate web.

The melon aphid produces 14-20 generations with in a season. It settles in the spring on sprouts, inhibits plant growth and sometimes leads to their complete destruction. In opening cotton bolls, the fibers are pasted together by the sticky excretions of the aphid, which renders the processing of raw cotton difficult. As a result of the prolific nature of these pests plantations

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become rapidly infested and infection spreads to new areas causing great losses to cotton growers.

To insure the complete destruction of cotton pests for the entire vegetative period, plantations must be treated with highly effective contact insecticides (thiophos, pyrophos) 3-4 times, since their action is not a lasting one and they do not kill the eggs of pests. Therefore systemic insecticides have proved to be more ideal preparations in the control of sucking cotton pests.

No matter what the degree of spider mite infestation of cotton crops, spraying with a 0.2-0.3% octamethyl or mercaptophos solution (600-800 liters per ha) will clear the plantation of spidermites, aphids, and thrips for a long period, for 30-40 days. No more than two mercaptophos or octamethyl treatments are required to insure complete protection of the yield, and in some cases one treatment is sufficient.

Mercaptophos and octamethyl applied in concentrations that impart in plants sufficient toxicity against sucking pests exert stimulating action upon plant development and the formation of yield. As a result of the complete and lasting destruction of pests and a direct stimulating influence upon plants there has been observed a yield increase of up to 60% as compared with control plots that have not been treated with systemic insecticides.

These preparations are no less effective in the control of sucking pests of citrus plants, tea, persimmons and the noble laurel. The most dangerous pests of these valuable crops are the red citrus mite, mealybugs, scale insects, and soft scales. The red citrus mite multiplies only on citrus plants, giving special preference to lemons. Under favorable conditions the mite can produce a whole generation within 30-32 days. Each female lays up to 30 eggs. During the summer the mites suck out the contents of the leaf cell and cause a general emaciation of the trees and crumbling of the leaves. Yield

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sometimes reach 30%.

All chemical measures carried out heretofore in the control of the red citrus mite proved ineffective regardless of the fact that numerous preparations were used, including anabasine and nicotine with soap, soap, DDT, Benzene hexachloride [GKhTsG], oil emulsion, contact phosphoro-organic preparations and fumigants). No matter how carefully treatments with these preparations were conducted [Begin p.33] they failed to produce a 100% mortality of the mite. Almost all of the preparations indicated either kill or repel the useful predators of the mite and within a month of such treatments the number of the pests can increase progressively. If the red citrus mite did not have natural enemies, it would be impossible to grow citrus plants. Numerous predators that subsist solely on red citrus mites settle in places in which the mites congregate and quickly destroy them. In many cases these useful predators stop mass reproduction of mites. Naturally, a combination of the biological and chemical methods produces the best effect in the control of citrus mites.

The use of the octamethyl preparation has a great advantage as compared with mercaptophos. Very badly infested lemons and mandarins are completely purged of the pest within 5-7 days when they are sprayed with a 0.2% octamethyl solution. Duration of action is three months. Even though the eggs of the mite are not injured by octamethyl, the larvae that emerge from the egg perish just as soon as they begin to suck the juice of a plant that has assimilated this preparation.

As indicated above, mercaptophos and octamethyl are toxic for man. Hence treatment of plants with these compounds must be conducted intelligently: on the one hand, it is essential that the highest toxicity of the plant coincide with the time when the natural incidence of the pests in

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mature is at its greatest and, on the other hand, that the products of the yield do not contain systemic poison at the time of harvesting, i.e. that sufficient time has elapsed for complete hydrolysis of the preparation. The absence of an adequate effect on injurious insects does not indicate a complete hydrolysis of systemic poison.

The presence of systemic poisons within the plant can be determined by various methods: by means of chemical determination of an insecticide, by the method of tagged atoms in the oven (the systemic insecticide contains a radioactive element (chiefly P_{32}), by the method of chromatography and, finally, by the biological enzymatic method. The latter method is not a specific one, but it is a very sensitive one, universal for all phosphoro-organic insecticides, it is based on the mechanism of their action.

Even the first researchers had discovered the capacity of phosphoro-organic compounds to inhibit the activity of the enzyme known as choline-esterase. This enzyme is distributed throughout the animal kingdom.

In the event the activity of choline-esterase decreases, there occurs an accumulation of [the animal's] own acethylcholine and, as a result, it is poisoned and dies.

Most authors believe that the fundamental cause of the death of insects as well as of warm-blooded animals under the influence of phosphoroorganic insecticides is the inhibition of choline-esterase. Phosphoro-organic insecticides even in negligible amounts ($1:10^{-7}$ M, $1:10^{-9}$ M) are capable of inhibiting this enzyme. Systemic insecticides acquire a great capacity of inhibiting choline-esterase only after they have been oxidized in the plants and in the animal organism. This quality of theirs underlies the enzymatic method of determining them in plant tissues. Phosphoro-organic compounds are extracted from the fruits of plants by liquids in which the given insecticide is freely soluble, further this extract is used to

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exert action upon choline-esterase (blood, brain suspension) the inhibition degree of which enables one to determine minimal amounts of insecticides (less than 1 : 10 000 000).

The domain in which phosphoro-organic compounds can be utilized is very extensive. Their capacity to inhibit choline-esterase can be utilized widely, for example, in medicine, in cases of different diseases when it becomes necessary to save acethylcholine of the organism. Thus, phosphacol, phosarbine (pyrophos), and armine are used in small amounts as therapeutic means in the control of some eye diseases.

We shall confine ourselves to merely mentioning the extensive area in which phosphoro-organic compounds can be used. A more detailed account of the problems of their application requires special consideration.

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879

Makarova, L. A.

K metodike agregatnogo analiza pochvy.

[Method for aggregate analysis of soil].

Pochvovedenie, no. 2, pp.92-93, 1955. 57.8 P34

(In Russian)

In determining the aggregate composition of soil by Savvinov's method, we encounter two shortcomings:

a) decomposition of aggregates when a dry batch of soil is immersed in water brought about by air bubbles found within the structural joints [otdel'nosti], as a result of which the data obtained concerning the content of water-stable aggregates is placed too low;

b) influence exerted by various inclusions (hardpan [ortshtein], pebbles, gravel, rubble etc) found in the soil, especially in the non-black soil belt, upon the results of the aggregate composition.

We made several parallel determinations of soil samples in an air-dry conditions and in a state of natural (field) moisture (table).

We, similar to the procedure of Savvinov's method, computed the analytical results of our determinations by an air-dry batch. After dry fractioning of the soil with natural moisture in sieves, we took two batches of 50 gm each that consisted of structural fractions in proportion to their content in the soil. One batch was used to determine water-stable aggregates (wet sifting), and the other was dried until it was in an air-dry condition. This batch was used to compute the analytical results.

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In determining the aggregate composition of soil in an air-dry state, the results obtained were several times lower than the results obtained from the same sample in a state of field moisture. The larger aggregates (more than 1 mm in size) deteriorated the most.

Thus, it may be considered that data of the aggregate analysis obtained in analyzing soil samples of field moisture reflect more fully the structural condition of the soil than those obtained in an analysis of samples in an air-dry state.

Podzolic soils, as a rule, always include in their composition hardpan grain which remain in the sieves when the aggregate of soil composition is being determined. [Begin p.93].

Table

Aggregate composition in percentages of the weight of air-dry soil. Medium podzolic light loam. Horizon Apakh [Cor. Apakh] Depth 0-20 cm.

No. of accumulation	Moisture of analysis sample	Size of fractions							
		>3	3-2	2-1	1-0.5	0.5-0.25	<0.25	>1	>0.25
2	Field	13.3	2.9	4.6	10.6	12.6	56.0	20.8	44.0
	Air-dry soil	0.5	0.7	1.2	6.5	15.9	75.2	2.4	24.8
10	Field	22.7	3.8	4.5	5.8	8.8	54.4	31.0	45.6
	Air-dry	4.1	0.8	1.4	6.8	20.3	66.6	6.3	35.4
12	Field	47.1	4.2	4.2	5.5	4.6	34.4	55.5	65.6
	Air-dry	1.3	1.1	2.2	11.2	19.4	62.8	4.6	37.2

Therefore, the data obtained on aggregate composition were overestimated. Some soils, including plowable horizons, contain up to 10% of hardpan grains.

Apart from this, after the washing there often are left in the sieves elements such as "soil skeletons" (gravel, fine detritus, fine pebbles) and

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sand particles, along with the tested aggregates. They all have a negative influence upon the results of aggregate analysis.

In defining the aggregate composition of soil, it is necessary to separate soil aggregates from such inclusions and new formations. We recommend that this be accomplished as follows.

From the soil fractions in sieves that have been dried (up to an air-dry condition) after the washing are removed the clearly visible grains of hardpan, gravel, pebbles etc. Then structural lumps are ground carefully (so as not to crush any hardpan) in bowls and sifted through a 0.25 mm sieve and then weighed. The result will represent the weight of the real water-stable aggregates.

Fine hardpan and coarse sand will be left in the sieve. These will be mixed with the hardpan and inclusions removed earlier from all fractions of each sample. The amount of all of these particles is subtracted from the air-dry (or converted to air-dry) batch used in the analysis.

Computation of the percent composition of water proof aggregates is carried out by means of estimating the air-dry batch minus all inclusions and hardpan. In thus determining the content of water-stable aggregates in the soil, we concomitantly exclude all inclusions that take no part in structural formation and interfere with the quantitative determination of aggregates.

CONCLUSIONS

1. In determining the aggregate composition of soil by N. I. Savvinov's method it is suggested that soil samples be taken not in an air-dry state, but with natural (field) moisture.

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2. The content of hardpan and various inclusions (pebbles, detritus, gravel etc.) in the soil, especially in the non-black soil belt, exert a strong influence upon the results of aggregate analysis. A method for the separation of these particles from the real water-stable aggregates has been suggested.

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[The Komi Branch of the Academy of Sciences, USSR
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Makarova, L. A.

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Kriukov, P. A., and Komarova, N. A.

Ob otzhimanii vody iz glin pri sverkhvysokikh davleniiakh.

[About squeezing out water from clays under ultra-high pressures].

Akademiia Nauk SSSR. Doklady, vol. 99, no. 4. pp.617-619, 1954. 511 P444A

(In Russian)

Studies of phenomena, connected to the separation of water from clays and certain other gels, were conducted by us in connection with a research of the composition of solutions, which saturate the soil, silts and sedimentary rocks. The basic part of the dry land's water is found in the structure of these solutions; they play a big role in the life of natural waters and in the chemistry of the earth's crust as a whole (1). During examination of soil, silt and rock solutions, data concerning the peculiarities of their physical state, conditioned by the reaction of the solid phase, is of great importance.

It is interesting to examine the relationships between the applied pressure and the equilibrium residual moisture because usually for the separation of soil solutions from soils, silts and rocks methods of squeezing out are utilized. This relationship, which characterizes the possibility of separation of solutions from objects with a natural, often very small, moisture can be utilized also during examination of natural processes of squeezing out solutions from silts and sedimentary rocks. At the same time it characterizes the interaction of the solid and the liquid phase more fully, than the so-called hydrological constants of soils and grounds - "the maximum

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molecular moisture capacity" and "the moisture equivalent", which are determined according to moisture which remains after squeezing out or centrifugation under only the standard conditions.

The cited relationship must be studied in a wide range of pressures, which corresponds both to the laboratory conditions of separation of solutions for their analysis, and to the natural circumstances. Squeezing out of solutions from sedimentary rocks under natural conditions proceeds not only at the expense of the pressure of the overlying strata, but often under the influence of much greater pressures of tectonic origin. A still wider range of pressures is desirable also for the studies of forces by which water is retained in gels, which reach, according to indirect data, tens of thousand of kilograms per 1 cm^2.

The existing methods for studies of compression relationships foresee the highest pressures of an order of tens of kg/cm^2. The existing data concerning some gels relates to pressures which seldom surpass 1,000 kg/cm^2 (2). For some soils we examined the relationship between the moisture and the pressure for squeezing out up to pressures of about 7,000 kg/cm^2 (2); after this the apparatus for pressing were improved and the range of pressures widened to 20,000 kg/cm^2.

For pressures up to 1,000 kg/cm^2 apparatus were used resembling those cited by us previously (3). For the attainment of pressures up to 20,000 kg/cm^2 an apparatus was used (see figure 1) with a reinforced (double) cylinder made of steel DKHN4M, which was treated thermally up to hardness Rc = 50. [Begin p.618]

Plungers were prepared from steel RF1, which was tempered up to hardness R_c = 64. For each pressure a separate experiment was conducted. For diminishing the friction of the object against the walls of the cylinder and for speeding up the process the width of the pressed layer comprised about

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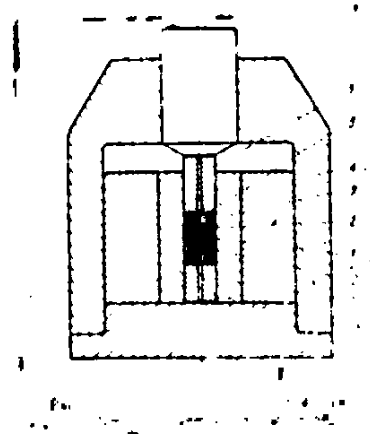
5 mm, and the squeezed solution flowed through the openings in both the lower and the upper plungers. Yet, in cases of objects with bad filtration ability, the equilibrium state, especially at maximum pressures, was set up slowly, and some experiments lasted up to 2 months. The residual moisture was determined by drying in a vacuum oven.

Examination was conducted on clays of various mineralogical composition: bentonite oglanlinskii, askangel and kaolin, as well as on certain other objects, particularly, on silica gel and starch, as, even for these classical gels in colloidal chemistry, data are almost entirely absent about their conduct during squeezing out in a wide range of pressures.



Title of figure 1. 1-soil, 2-sand, 3,4-cylinders, 5-plungers, 6-grids.

Results of some of our experiments were shown in figure 2 in the form of relationship of equilibrium moisture, indicated in percent with respect to the dry substance, to the logarithm of applied pressure.

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The obtained results permit to discern two basic types of relationship of moisture to the pressure of squeezing out. The first is characteristic for inorganic gels: silicic acid and clays. Here we have a continuous decrease in moisture with the increase of pressure, where-upon for the greatest part of objects the relationship of moisture to the logarithm of pressure is close to linear. A dependence of a similar character was observed by us in soils also (5). For starch (as well as for the examined by us agar-agar and peat) at the beginning moisture decreases quickly according to the logarithmic law, and, subsequently, after reaching a pressure around 2,000 kg/cm^2 it practically stops to decrease. The residual moisture for starch comprises 30.3%, whereas the bound water, which was calculated from the heat of swellings, comprises 31% (4). Unsqueezable moisture for Sphagnum peat comprises 54% and for agar-agar 30%. Thus, only for this group of objects the presence of unpressed water is apparent. A special position is occupied by askangel which appears to be, as it is known, one of the most hydrophilic among inorganic gels.

The discovered relationship of moisture to pressure points, first of all, to the fact that for the objects examined by us the basic significance in the retention of water is in the physical properties of the water itself in these systems, which are conditioned by the interaction with the solid phase, but not the mechanical stability of the skeleton, which plays a great role in the theory of dynamics of the ground mass. Actually, unsqueezable moisture is found in such objects (starch, peat) for which it is impossible to imagine the existence of a mechanically stable skeleton. For inorganic gels phenomena of structural stability manifest, as it is known, even in diluted suspensions, but [Begin p.619] in the range of high and ultra-high pressures the stability of the skeleton, of course, is transcended.

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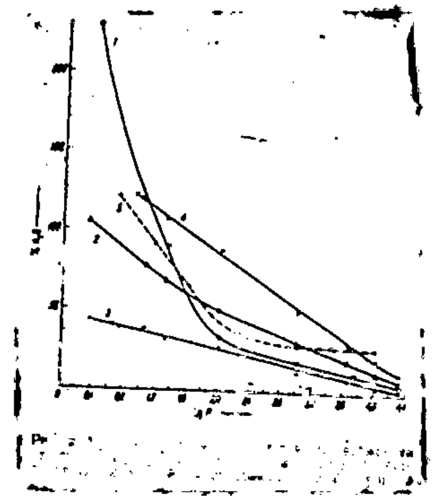

Title of figure 2. Curves of relationship of residual moisture to the pressure of squeezing out. 1-Askangel, 2-bentonite, 3-kaolin, 4-silicic acid, 5-starch.

It is necessary to compare the obtained data with the idea, prevailing up to now (5), about the moisture film as a special category of water, which in its energy is sharply different from free moisture. This idea and methods based on it, for determination of "maximum molecular moisture capacity" were found to be faulty (3,6,7) yet they are still being utilized. Our data for inorganic gels did not disclose any special points on the curves of squeezing out which would correspond to the maximum molecular moisture capacity, which, thus, has a purely provisional value. A characteristic of the hydrophilic nature of the solid phase determining equilibrium moisture for one pressure (or one centrifugal force) can be insufficient even for the purpose of comparision. Thus, for instance the relative hydrophilic nature of bentonite and askangel, evaluated by moisture, specific to various pressures, proves

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to be different.

Data, cited by us, as well as our experiments on squeezing solutions from various native sedimentary rocks show that mountainous moisture in the sedimentary rock strata prov[illegible] to be a dynamic element in the balance of underground waters. Almost [illegible] by silts in the process of sediment formation, can be squeezed out fr[illegible] the sedimentary rocks during the process of epigenesis, especially if these rocks are subject to pressures of tectonic character. This makes it [illegible] imperative to pay greater attention to the studies of the role of the [illegible] of squeezing out the solutions from the sedimentary rock strata i[illegible] genesis of underground waters. It is also necessary to accumu[illegible] in regard to the relationship between the pressure of squeezing out and the moisture content for natural soils, which can be utilized particularly for the evaluation of maximum pressures to which these soils were subjected during the process of epigenesis.

Entered March 12, 1954.

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(In full)
vg/M

Sochevanov, N. N.

Kolichestvennaia zakonomernost' mezhdu uprugost'iu vodianogo para i kolichestvom vody, sorbirovannoi pochvoi.

[Quantitative regularity between the resilience of water vapor and quantity of water sorbed by the soil].

Pochvovedenie, no. 9, p.49-55, September 1955. 57.8 P34

(In Russian)

The process of sorption of water vapor by the soil, depending on the moisture content in both the soil and the air, is elucidated in detail in the Soil Science literature.

K. V. Speranskii (3) placed soil with lesser moisture than its maximum hygroscopicity into enclosed space and after establishing an equilibrium determined the dew point in the space above the soil. Absolute and relative moisture content of air was determined according to dew point and temperature.

K. V. Speranskii's experiments did not include the field of low values of the relative humidity of air. The lowest values of this last one in his experiments ranged in the limits of 0.23-0.41.

As a result of the conducted experiments, K. V. Speranskii suggested a formula for computing the amount of water in the soil depending on the elasticity of water vapor;

$$a = a_o + \left(\frac{P}{P_o}\right)^2 \qquad (1)$$

In this formula, which received in literature a title "formula of Speranskii":

"P"-an absolute equilibrium elasticity of water vapor;

"P_o" an absolute elasticity of water vapor saturating the space at

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the same temperature;

"$\frac{P}{P_0}$" is the relative equilibrium elasticity of water vapor;

"a" is the amount of sorbed water per unit of mass of dry soil;

"a_0" and "K" are constant magnitudes.

As the subsequent checking by A. A. Rode (2) has shown, computation according to Speranskii formula usually coincided well with the observed magnitude for the interval of value of magnitude $\frac{P}{P_0}$ from 0.35 to 0.87. In certain cases the interval of coincidence of computed and practical data was still smaller.

Later research was conducted by Kuron with many natural objects - soils and clays. The procedure used by him was to keep the weighed portions of soil in desiccators over solutions of sulfuric acid of various concentrations.

Variations in the concentration of sulfuric acid in the limits of 10-74% gave a possibility to change the moisture of air over the examined weighed portions in wider ranges ($\frac{P}{P_0}$ from 0.942 to 0.034) and to include the interval of the starting phase of sorption of water vapors by soils, which were not examined by Speranskii.

Kuron has shown that, in the interval from low values of $\frac{P}{P_0}$ up to 0.26-0.38, $a = f\left(\frac{P}{P_0}\right)$ coincides well with the sorption equation of Freundlich:

$$a = \alpha \left(\frac{P}{P_0}\right)^{\frac{1}{n}} \qquad (2)$$

where "α" and "n" are constants. Values a, P, P_0 have the same values as in the Speranskii formula.

As A. A. Rode (2) points out "all 49 tested objects by Kuron displayed excellent compliance to Freundlich's equation during the starting phases of the sorption process, that is at low relative resiliencies of water vapor, which do not exceed magnitudes of 0.383".

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The author of the present article had to examine certain regularities for porous quaternary deposits. As a result of conducted works relationships were obtained [Begin p.60] which were similar to curves

$$a = f\left(\frac{P}{P_0}\right). \qquad (3)$$

Analysis of these curves has shown that a general equation, which will meet the demands of curves along the full range of variations is an equation of a type:

$$n = K.e^{-ma^2}. \qquad (4)$$

Here, for the case in question on sorption of water vapors $n = 1 - \frac{P}{P_0}$;

"a" - the amount of sorbed water per unit of weight of dry soil;

"e" - the base of natural logarithms

K, m - constant values.

By taking logarithms for this equation we have:

$$\lg n = \lg K - ma^2 \lg e. \qquad (5)$$

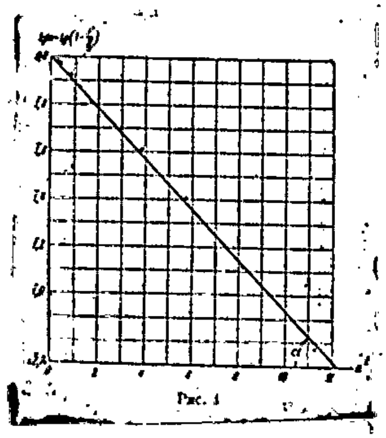

Figure 1.

As K, m and lge are constant values, the validity of this formula for the sorption of water vapor can be easily checked, if this inter-

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connection can be depicted graphically, plotting logarithm "n" along one axis and "a^2" along the second in the usual linear scale.

During such plotting $\lg n = \lg (1 - \frac{p}{p_0})$ and "a^2" - a square of the observed value of the sorbed moisture, must produce rectilinear relationship.

Data adduced in the above cited work of A. A. Rode about the magnitude of sorption for chernozem and podzolic soil were plotted by us in such coordinates and gave practically straight lines with a spread which was conditioned, probably, by small errors of the experiment.

Rectilinear relationship proves the justice of utilization of the given formula for the phenomenon under consideration.

A graphic interconnection $\lg (1 - \frac{p}{p_0}) = f (a^2)$ for the podzolic soil (horizon 36-45 cm) was depicted in figure 1; values were taken from the work of A. A. Rode (table 8a on page 69).

Initial data were given in table 1, and the diagram in figure 1 was plotted on their basis.

All the constants necessary for the solution of the equation were obtained from the diagram.

Point of interception of the straight line with the axis of ordinates determined the magnitude $\lg n = \lg K$, as the second multiplier of the equation (4) e^{-ma^2} under these circumstances ($a = 0$) reverted to 1. In the given case $\lg k = 0$ and $K = 1$. [Begin p.5]

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Table 1.

$\frac{P}{P_{\text{бс}}}$	$n = 1 - \frac{P}{P_o}$	a	lg n	a^2
1	2	3	4	6
0.942	0.058	3.35	$\bar{2}.764$	11.22
0.868	0.132	2.87	$\bar{1}.120$	8.24
0.748	0.252	2.40	$\bar{1}.401$	5.76
0.595	0.405	1.96	$\bar{1}.608$	3.84
0.354	0.646	1.30	$\bar{1}.810$	1.69
0.260	0.740	1.09	$\bar{1}.869$	1.19
0.164	0.836	0.88	$\bar{1}.921$	0.77
0.064	0.936	0.59	$\bar{1}.971$	0.35
0.034	0.966	0.45	$\bar{1}.984$	0.20

Solution of equation (6) in relation to "m" gives:

$$m = \frac{\lg K - \lg n}{a^2 \lg e}$$

considering that lg K = 0

$$m = -\frac{\lg n}{a^2 \lg e} \qquad (6)$$

But in the selected system of coordinates (see figure 1)

$$\frac{\lg n}{a^2} = tg\alpha,$$

whence

$$m = -\frac{tg\alpha}{\lg e} = -\frac{tg\alpha}{0.434}. \qquad (7)$$

Thus, we obtained the value of "m" from the tangent of the angle of the slope to the straight line of the axis of abscissa.

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For the case in question, according to (6),

$$m = \frac{1.3}{12.2 \cdot 0.434} = 0.245$$

Consequently the equation sought

$$1 - \frac{P}{P_o} = n = K \cdot e^{-ma^2} = e^{-0.245a^2}$$

or when solved in relation to K

$$a = 3.08\sqrt{-\lg n} = 3.08\sqrt{-\lg\left(1 - \frac{P}{P_o}\right)}.$$

Table 2.

$\frac{P}{P_o}$	$-\lg n$	$\sqrt{-\lg n}$	$a = 3.08\sqrt{-\lg n}$	"a" observed	a, computed from formula: Speranskii	Freundlich-Kuron
1	2	3	4	5	6	7
0.942	1.236	1.112	3.40	3.35	3.22	2.00
0.868	0.880	0.938	2.87	2.87	2.87	1.93
0.748	0.599	0.774	2.37	2.40	2.40	1.81
0.595	0.392	0.626	1.92	1.96	1.88	1.63
0.354	0.190	0.436	1.33	1.30	1.32	1.29
0.260	0.131	0.362	1.11	1.09	1.17	1.12
0.164	0.079	0.279	0.86	0.86	1.07	0.91
0.084	0.029	0.170	0.52	0.59	0.01	0.61
0.034	0.016	0.126	0.39	0.45	1.00	0.45

[Begin p.52]

Coefficient before the radical is determined by means of conversion (5):

$$a^2 = -\frac{\lg n}{m \lg e}, \text{ that is } a = \sqrt{\frac{\lg n}{m \lg e}} = \frac{\sqrt{-\lg n}}{\sqrt{m \lg e}} =$$

$$= \frac{\sqrt{-\lg n}}{\sqrt{0.245 \cdot 0.434}} = \frac{\sqrt{-\lg n}}{\sqrt{0.106}} = \frac{\sqrt{-\lg n}}{0.326} = 3.08\sqrt{-\lg n}$$

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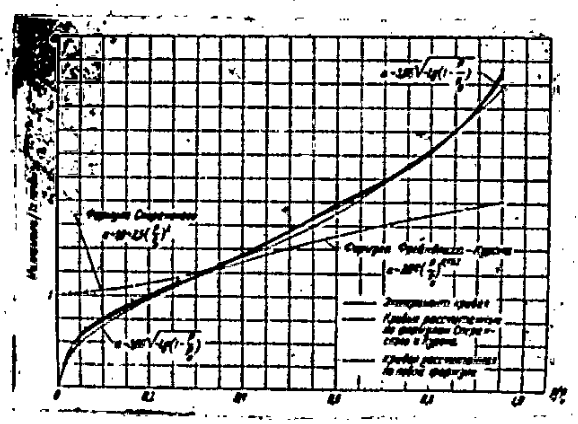
Words in figure 2. Left outside the figure: Millimoles/1g of soil.
Left side, inside the figure: Formula of Speranskii
Right side, inside the figure: Formula of Freundlich-Kuron

o____o Experimental curve
____ Curves, computed according to formula of Speranskii and Kuron
o____o Curve, computed according to a new formula.



Title of figure 2. Curves which indicate the amount of moisture, adsorbed by the soil, in relation to relative elasticity of water vapor. Podzolic soil, horizon 36-45 cm.

Then, for the case in question, using equation (8), it was easy to compute the amount of sorbed moisture, which was done in table 2.

Columns 1 and 2 in table 2 correspond to columns 1 and 4 in table 1 (but the values of the logarithm from column 4 were converted - the characteristic and mantissa of the logarithm were brought to one sign).

Column 4, in table 2, was the final result of computations of the magnitude "a". In column 5, for the possibility of comparison, value of the observed "a" was given, in column 6 - the "a" computed, according to formula of Speranskii $a = 1.0 + 2.5 \left(\frac{p}{p_o}\right)^2$, and in column 7 - according to formula of

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Freundlich-Kuron $a = 2.04(\frac{P}{P_0})^{0.452}$, which are given by A. A. Rode (2, page69) for this relationship.

In columns of computed values of "a" those are boxed which tally satisfactorily with the observed values of this magnitude.

As it is seen from table 2, the formula suggested by us underestimates somewhat the magnitude "a" in the range of low values of $\frac{P}{P_0}$.

If one plots graphically (figure 2) the values of the observed magnitude of sorption and of those computed according to the suggested formula, it will be s[illegible] deviat[illegible] have no value in the main and our calculated c[illegible] coincides with the experimental curve of sorption.

For comparison [illegible] us give another instance [illegible] sorption by chernozem (horizon 67-74 cm), borrowing from the work of A. [illegible] Rode the experimental and calculating data according to the two previously [illegible]ting formulas (2, page69) and supplementing with [illegible] a d[illegible] according [illegible] our formula.

Formulas follow, according to which data were obtained for table 3:

$$(1)\ a = 8.3(\frac{P}{P_0})^{0.6}. \qquad (2)\ a = 1.60 + 3.50(\frac{P}{P_0})^2.$$

$$(3)\ a = 4.60\sqrt{-\lg\left(1 - \frac{P}{P_0}\right)}.$$

[Begin p.53]

These same data were depicted in figure 3, it is seen there that a single point, which showed a considerable deviation between the calculated data, according to the suggested formula and the observed magnitude was not too essential for the whole course of the sorption curve.

In the work of A. A. Rode (2, page 64) in figure 20, according to data of Kuron for the examined soils from Versingav, curves are given showing the amount of vaporous moisture, adsorbed by the soil, in relation to relative elasticity of vapor for various fractions of these soils.

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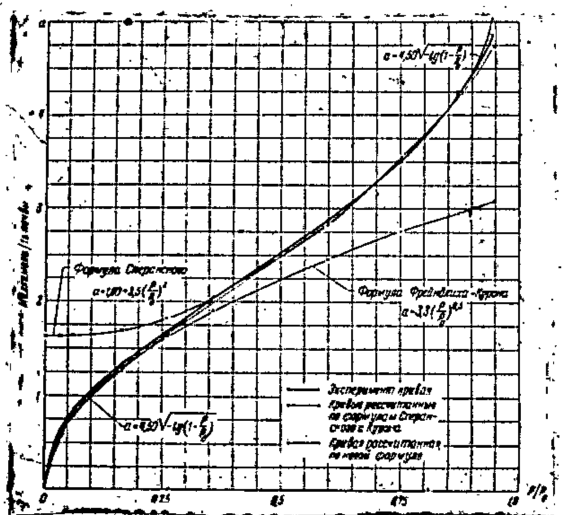
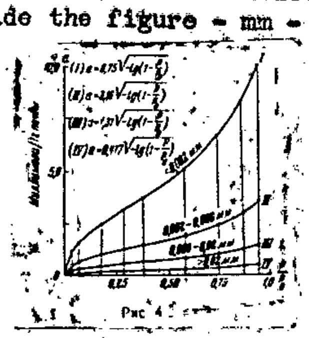
Words in figure 3. Left, outside the figure: Millimoles/1g of soil.
Left, inside the figure: Formula of Speranskii
Right, inside the figure: Formula of Freundlich-Kuron

o——o Experimental curve
—— Curves, calculated according to formulas of Speranskii and Kuron
o——o Curve computed according to the new formula.



Title of figure 3. Curves, which indicate the amount of vaporous moisture, adsorbed by the soil, in relation to relative elasticity of water vapor. Chernozem, horizon 67-74 cm.

Words in figure 4. Left outside: Millimoles/1g of soil.
Inside the figure - mm - millimeter.



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Applicability of the suggested formula has been checked on all these four curves (figure 4). Differences proved to be of the same order, as for the previously examined two curves, notwithstanding the sharply differing character of the curves.

Examination of the obtained formulas permits to establish a connection between the coefficient "b" in formula (9):

$$a = b\sqrt{-\lg\left(1 - \frac{P}{Po}\right)} \qquad (9)$$

and the mean diameter of particles (q) in the soil.

An assumption was expressed that the amount of sorbed moisture is inversely proportional to the diameter of particles in the sorbing fraction of soil, that there is a relationship.

$$b = \frac{K_o}{q}, \qquad (10)$$

where "b" is a coefficient before the radical in formula (9);

"K_o" - a constant magnitude;

"q" - a mean diameter of soil particles in mm. [Begin p.64]

If one takes log of formula (10), then

$$\lg b = \lg K_o - \lg q.$$

Table 3.

$\frac{P}{P_o}$	"a" calculated			"a" observed
	According to Freundlich-Kuron (1)	According to Speranskii (2)	According to the suggested formula (3)	
0.034	0.58	1.6	0.57	0.62
0.064	0.83	1.61	0.77	0.85
0.164	1.28	1.67	1.26	1.32
0.260	1.61	1.81	1.63	1.65
0.354	1.88	2.01	1.96	2.01
0.595	2.44	2.61	2.82	2.86
0.748	2.73	3.54	3.48	3.48
0.868	2.94	4.21	4.22	4.20
0.942	3.07	4.71	5.00	4.82

Diagram of function lg b, depending on lg q, plotted in logarithmic

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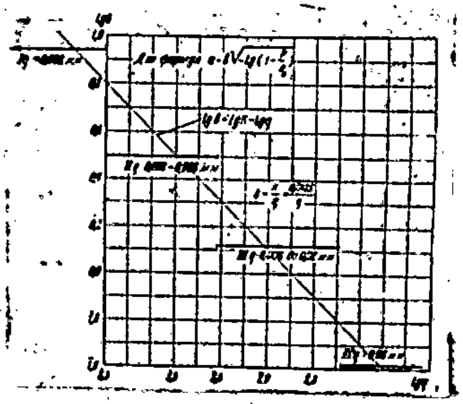
coordinates, must represent a straight line.

Words in figure 5. Left outside mm.
Inside the figure at the top: for formulas
Inside the figure at the bottom - mm - millimeters



Title of figure 5. Relationship between coefficient "b" and the size of soil particles "q"

Group	I	II	III	IV
Actual size in mm	< 0.002	0.002-0.006	0.006-0.02	> 0.02
Mean size in mm, calculated according to formula $q = \frac{0.0126}{b}$	0.0014	0.004	.0096	0.03

This dependence is depicted in figure 5. The straight line drawn in figure 5 corresponds to formula:

$$b = \frac{0.0126}{q}, \qquad (11)$$

[Begin p.55]

which confirmed the assumption about the presence of inverse proportionality between the coefficient "b" before the radical in formula (9) and the mean size of particles, comprising the given soil specimen.

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Conclusions

1. The suggested equation

$$a = b\sqrt{-\lg\left(1 - \frac{p}{p_0}\right)},$$

which established an interconnection between the amount of sorbed moisture and the relative elasticity of water vapor assured a sufficiently good coincidence with actually observed magnitudes along the full range of changes of $\frac{p}{p_0}$.

2. Freundlich's formula, an empiri[illegible], was originally utilized for a case of sorption from [illegible] and [illegible] a good convergence with data of the experiment onl[illegible]ions in solutions.

Its utilization [illegible] for a case of [illegible]ption of water vapor by the soil was not sufficiently substantiated.

3. Propositions, known from literature, about the interconnection of the sorption isothermal curve in one of its part with the mechanism of interaction of vapor and sorbent, and in another part with the principle of the theory of condensation were not yet a basis for describing the whole curve by two formulas of the Langmuir-Thomson type (1) or for the selection of empirical binomial equation, which take into account both processes.

Apparently, as $\frac{p}{p_0}$ increased the influence of one process gradually decreased, and the influence of the second process grew, while the summary effect of sorption conformed to the suggested new formula with an exactness sufficient for the purpose of practice (1).

4. This formula can be of help also during the analysis of hysteresis of water vapour (2, page 75) and of curves of sorption by soils, which were saturated with different cations (2, p.97) having established a relationship between a coefficient "b" and the appropriate ionic potentials.

(1) Unfortunately, the author does not give an example for a parallel calculation of specific materials with the use of other appropriate rational formulas which would give an idea about the limits of the possible use of his empirical formula. Editor's remark.

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In conclusion the author thought it necessary to express his gratitude to a student of the Leningrad Mining Institute, V. A. Artsybashev, who conducted the main calculations for the given work.

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Entered the Editor's office 19 February, 1954.

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Trans. A-882
(In full)
vg/M

Tarakanov, G. I.

Rol' termicheskogo faktora v pereraspredelenii vlagi v pochve.

[Role of the thermal factor in redistribution of moisture in the soil].

Pochvovedenie, no. 9, pp.25-36.
Sept. 1955. 57.8 P84

(In Russian)

A continuity between the water - air and the thermal regimes of the soil is carried out through evaporation from the surface of the soil, as well as through the processes of intrasoil evaporation and condensation.

Slight studies of these processes by soil hydrology and inconsistency of some hypotheses, which were brought forward by certain researchers, about the nature of these processes and their influences on the distribution of moisture in the soil made us engage in experimental research of the hydrothermic regime, which is formed during specific hydrothermic conditions in a model soil.

Inasmuch as phenomena of intrasoil evaporation and condensation are conditioned, to a considerable degree, by movement of the soil moisture in its gaseous form under the influence of a temperature gradient in our experimental research we gave special attention expressly to dynamics of the soil moisture in the form of vapor.

For the accomplishment of this research a laboratory setup was constructe (figure 1), which consisted of: 882

1) a container, to be filled with the soil;

2) of two recipient - thermostats, which were placed on top and on

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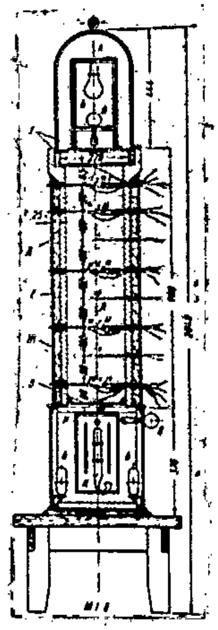
the bottom of the container and which were in communication with the container;

3) of a series of apparatus and instruments for regulation and measuring of temperature and moisture of the soil that filled the container and of the air in its pores, as well as temperature and moisture of the air in the recipients.



Title of figure 1. Cross section of a laboratory setup for an experimental study of hydrothermic regime of the soil:

A - the upper recipient, Б - electric bulbs; B - bimetallic thermoregulator; Г - rubber gaskets; Д - earthenware pipe; E - thermal insulation (felt); Ж - casing; З - grid; И - the bottom recipient; K - "Avgusta" [Augustus?] psychrometer; Л - sand; 1 to 10 "soil" thermocouples; 11, 13, 15, 17, 19 - "dry" thermocouples; 12, 14, 16, 18, 20 - "wet" thermocouples.

The container was made of a thermo and moisture insulated earthenware pipe, about 1 m high and inside diameter of 200 mm. The soil, loaded into it was held back by a brass grid fastened to its bottom.

The upper recipient consisted of a glass bell, 250 mm in diameter and

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450 mm in height. The bell rested on a ring base of a duralium support, which in its turn rested on the butt of a massive steel bushing, which was inserted into the mouth of the earthenware pipe. [Begin p.26]

To the duralium support were affixed: a 75 watt electric bulb; a bimetallic thermoregulator, a chemical stick thermometer and the psychrometer "Avgusta".

On the flange of the bushing rested an electroheating ring with the aid of which was attained a uniform heating of the surface of the material being loaded into the pipe as well as for averting the flow of moisture, which became condensed on the walls of the glass bell (during the experiments), down into the soil.

A cotton jacket was put over t[illegible] bell in order to prevent heat exchange between the recipient and the surrounding air.

At the bottom, the lower [illegible] was linked to the earthenware pipe by a steel band; this recipient represented a duralium cell, having a form of a parallelepiped with sides of 32/32/36 cm. A hatch, 200 mm in diameter, was made in the ceil[illegible] cell for a connection with the interior of the earthenware pipe. In the front side of the cell was made a transparent door of organic glass. To the door a mercury stick thermometer was attached, and to the back wall of the cell - the psychrometer "Avgusta". Temperature of the air in the bottom recipient was regulated with the aid of a bimetallic thermoregulator and of two pair of 25 watt bulbs; and the bulbs of each pair were connected to each other in succession, so that the total power of the used current was 25 watt.

For observation of the temperature field of the soil, which was being loaded into the earthenware pipe, as well as the fields of temperature and moisture of the air, circulating in its pores, there were prepared and

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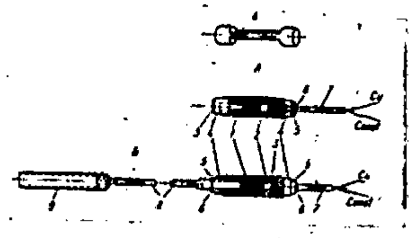
mounted into the apparatus 24 copper-constantan thermocouples with a summary resistance in each of 24.5 ohm. Ten of them, so-called "soil" thermocouples, were arranged for measuring temperature of the soil in 10 points along the axis of the pipe; the remaining 14 - seven "dry" and seven "moist", which represent, when combined in pairs of "dry" and "wet" thermocouples, seven electric micropsychrometers, were intended for measuring the temperatures and moisture content of the air in the pores of the soil at different horizons, as well as in the recipients (in order to control the reading of psychrometers "Avgusta".



Title of figure 2. Layout of pickups of "dry" and "wet" thermocouples:

A - "ogolovok" "[head] of "dry" thermocouple; Б - "ogolovok" [head] of "wet" thermocouple; 1 - junction of thermocouple; 2 - "koraksovye" [made of fine-pored porcelain] tubes; 3 - brass grids; 4 - holder of brass grids; 5 - rubber stoppers; 6 - "mendeleevskaia" [mendeleevium?] cement; 7 - rubber tubes, into which were introduced both the copper and the constantan wires of the thermocouple; 8 - rubber water-feeding pipe - cannula; 9 - glass nozzle of the feeding tube.

To provide a necessary contact between the soil and the junction of "soil" thermocouples tinned copper kopeck-sensitizers were soldered to them, as sensitive parts.

Pickups of the "dry" and "wet" thermocouples were arranged in the following manner (Figure 2).

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junctions of thermocouples were inserted into tubes, made of fine-pored porcelain, with an inner diameter of 0.5 mm, outside diameter 2 mm and 25-30 mm long. In order to protect the porcelain pipes from direct contact with the ground and, thus, shut out conductive heat exchange between them, each procelain tube was enclosed in a holder made of a 5 mm diameter copper tube, to which a brass grid was soldered on. The porcelain tubes were held in place in the holders with the aid of rubber stoppers. A similar arrangement of thermocouple pickups also protected "dry" thermocouples from soil moisture. In "wet" thermocouples onthe contrary, the porcelain tubes, during the experiment, had to be kept in a moist state; for this purpose the free ends of porcelain tubes were inserted into rubber feeding tube-cannula (diameter in the light ~1 mm), through which distilled wat[illegible] fed into the porcelain tubes. Over the protruding ends of feeding [illegible] nozzles were placed, which are able to retain for a long time a certain supply (a few drops) of water, necessary for the continuous moistening of "wet" porcelain tubes of the thermocouples. Continuous moistening was attained by fastening the nozzles at the level of the proper thermocouples. [Begin p127]

Each of the thermocouples, being connected, through a commutator, in turn with one of the two "zero" thermocouples, which were sunk into a Dewar vessel with melting ice, can be connected to a reflecting galvanometer, which, reflecting the flash of light that fell on its mirror from the illuminator to a calibrated scale, shows the temperature at the point of mounting of a thermocouple.

Identity of the galvanometer scale to the scale of Celsium was achieved by a partial insertion into the circuit of the galvanometer of the siemens shunt. Accuracy of the reading of temperature comprised the ~0.05°.

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because one millimeter graduation of the scale corresponded to 0.1°. Yet, the precision in measuring the differences of temperature of adjoining "dry" and "wet" thermocouples (that is of psychrometric changes which interested us to begin with) was much higher and reached 0.02° because for measuring such differences into the circuit of the galvanometer, only two - a "dry" and a "wet" thermocouple were inserted successively, the "zero" thermocouples and the siemens shunt were disconnected, and while the siemens shunt was cut off, the shifting of "zaichik" [reflected light ray] on the galvanometer scale under the action of a similar impulse increased by 3.63 times.

Re-distribution of moisture in the soil in a condensed form (in droplets, liquid) during the course of experiments was rated by means of taking test specimens for moisture content, which were taken with a special sludge pump through the extraction branch pipes, which were built-in into the sides of the earthenware pipe. The sludge pump was made from thin brass pipe, with a diameter of about 5 mm and a brass shaft, which was tightly fitted inside the pipe. Graduations were applied to both the pipe and the shaft which permitted to take test samples of sand from any previously planned distance from the axis of the earthenware pipe. All the testspecimens which comprised, on the average, 3.6-4.0 g were taken at a distance of not less than 6 cm from the walls of the container. During extraction of each new batch of sand for a repeated determination of its moisture the sludge pump was introduced gradually still deeper into the sand which was not touched till that time. All sand extracted from the container, with the exception of the removed batch, was injected back with the aid of that same sludge pump, and the remaining emptiness after this near the walls of the container, which corresponded to the size of

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the batch, was filled with fresh sand with a moisture content almost similar to that in the batch. Weighing of batches of the moist and of the dry sand was conducted on a precision analytical balance.

A column of medium-grained (with a diameter of particles of 0.5-1 mm) winnowed and washed alluvial sand served as a model soil for all the experiments; it was poured into the container of the laboratory set-up in an air-dry state. The role of structural elements of soil, that is, of the clumps of soil which are pierced by microcapillaries, was performed in our model by porcelain tubes, which surrounded the junctions of "dry" and "wet" thermocouples.

The first experiment was in a formation in the column of air-dry sand of a stationary heat flow and a consequent clarification of peculiarities of the profile of sand temperature corresponding to such a flow.

For this purpose, after filling the laboratory set-up with sand and an arrangement there of the thermocouples, the heating apparatus of the upper and lower recipients were switched on and after that, during the course of 28 days and nights, with the aid of thermoregulators the temperature was constantly maintained in the upper recipient at the level of 45° and in the lower at the level of 20°. Daily, four times a day, readings were taken of all "soil" thermocouples, according to which later on temperature curves were drawn, which reflected the re-distribution of temperature in the sand during the whole period of observations (table 3).

A characteristic peculiarity of all temperature profiles is the curvilinearity of their outline whereupon, during the course of the last twenty days of the experiment, the temperature curves, retaining their semi-crescent shape, almost repeated one another along the greater part of their amplitude.

The, thus achieved, practical stability of temperature curves testi-

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fied to the constancy of density of the heat flow in time in each cross-section orthogonal to its course. At the same time a sharp variability of temperature gradients along the height of the sand column pointed out that the amount of heat, which was transmitted from top to bottom, from layer to layer, declined gradually.

The cause of this was that in porous bodies, heated from above, distribution of heat by means of thermal conduction is complicated by phenomena of convection and circulation of gases inside the pores.

Schematically one can present the process of distribution of heat in such bodies in the following manner. [Begin p.28]

Heat is transmitted from the heated surface deep into the body preferably along the hard particles (skeleton) of the body. At the same time, the air, which is usually mixed with water vapor diffuses through the pores of the body. Moreover, "heavy" gases, of which the dry air consists, that is, nitrogen, oxygen and carbon dioxide, occupying a predominant position in pores and moving down, mostly through the center of the pores, tend to displace from the pores the light water vapor, forcing it first of all to the walls of the pores. Becoming heated near the warm walls, water vapor expands, after which it independently rushes upwards still clinging to those same walls of the pores. Thus arise the convectional currents in the pores of the body. Moreover, the ascending currents of water vapor that arise from within the interior, colder parts of the body, cool the sides of the pores and, thus, prevent the entry of heat inside the body. A more or less intensive heating of the body, by "heavy" gases (dry air) infiltrating it, is also hampered, because of the consequence of reciprocal interferences, which the ascending and the descending currents of gases set up for each other; microscopic circulating loops

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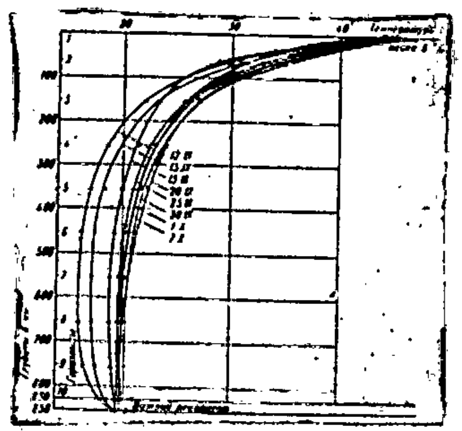
(microconvolutions) which equalize the temperature of the ascending and descending gases are formed in the extensions (the cells) of the pores.

Figure 3. Words in upper right corner: Temperature of sand in ° of Celsium
Lower left corner, outside: depths in mm
Lower left corner, inside: horizons
Along the lower line: the lower recipient.



Title of figure 3. Sequential changes of the temperature profile of the column of sand at a general drop of its temperature Δt = t upper = t lower = 45-20 = 25°C = const.

That is why when estimating the heat transfer in capillary - porous bodies, particularly in soils, it is necessary to take into consideration all these phenomena; introducing for instance, into the estimate the so-called equivalent coefficient of thermal conductivity, λ-eqv, which takes

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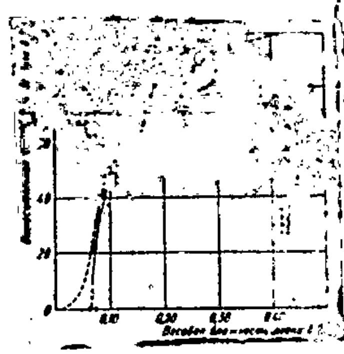
into account the influence of convection, which attenuates with depth (1).

[Begin p.29]

Parallel with experiments on studies of the mechanism of migration of heat and moisture in the model soil, research was conducted on the adsorption abilities of the experimental sand according to the dynamic method of I. N. Antipov-Karataev. As a result of research isotherms of sorption of moisture by sand (fig. 4) were obtained and relation of maximum hygroscopicity of sand Wg to its temperature t was detected, according to which : $Wg = 0.4707-0.00584\ t$, where t - in °C, and Wg = in weight percentage.

Words in figure 4. To the left: Relative humidity of air in %.
Under the figure: [illegible] in %.



Title of figure 4. Isotherms of sorption of moisture by alluvial quartz sand with a diameter of particles from 0.5 to 1.0 mm:
1- equilibrium moisture at different y and at t = 10.2+11.4°C;
2- equilibrium moisture at different y and at t = 15.6°C;
3- equilibrium moisture at different y and at t = 25.0°C; equilibrium moisture at different y and at t = 40.0°C.

Footnote (1). To compute this coefficient the author of the article recommends the following formula:

$$\lambda_{eqv} = \lambda_0(1 + bt)\left(1 + \frac{\varepsilon_0 - 1}{e^{cz}}\right) = \lambda\varepsilon_z$$

where $\lambda = \lambda(1 + bt)$ is the actual coefficient of thermal conductivity of the soil; this coefficient represents a linear function of its temperature t; λ_0 represents a coefficient of thermal [the footnote is continued at the bottom of page 29] conductvity of the soil at temperature of 0°; $\varepsilon_z = 1 + \frac{\varepsilon_0 - 1}{e^{cz}}$ is a variable

[Footnote continued on the top of next page].

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multiplier, which is computed on diminution of the depth of z, which is formed by convection; ε_0 = value of the coefficient of convection at the surface of the soil (when z = 0); b, c and e are constants.

All the constant values, which enter the formula for λ_{eqv}, can be determined in an experimental way.

Later on our attention was focused mainly on experiments studying the re-distribution of moisture in the soil (sand), by observing the phenomena of transpart of temperature and buoyancy of water vapor, which arise in its pores under the influence of vertical gradients. These experiments were conducted on the laboratory set-up cited previously.

The necessary drop of temperature between the upper and lower end of the sand column, which filled the container of the laboratory set-up, was formed, as it was in the first experiment also, by the electroheating apparatus in both the upper and the lower recipients. The necessary moisture of air over the sand column was maintained with the aid of supersaturated solutions of several salts (NaC[illegible] K_2SO_4, and $K_2CO_3 \cdot 2H_2O$), which were added from special vessels into [illegible] upper recipient. Utilization of different solutions gave a possibility to vary the relative moisture of the air in it in the limits of 69-90%. For a maximum moistening of air at the base of the sand column flat pans with distilled water were placed in the lower recipient during all the experiments. Observations of the field of temperature and moisture [Begin p.80] of sand and intraporous air were conducted with the aid of apparatus and devices, with which the set up was equipped and which was mentioned before.

The central place in our researches was taken up by a series of experiments studying the movement of moist air in the sand with a temperature gradient directed from below upwards, that is under the influence of a descending flow of heat that a given moisture of air along the edges of the sand column.

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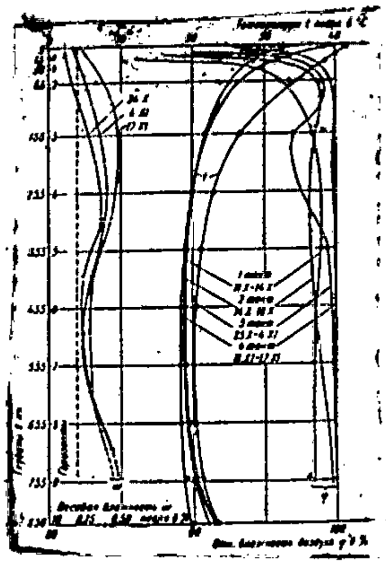
Words in figure 5. At the top - temperature t of sand in °C; inside the figure: 1st cycle, October 10-14; 2nd cycle, October 14-18; 3rd cycle, October 25 to November 4; 4th cycle, November 11 to 17. At the bottom of the figure: outside left - depths in mm; inside left - horizons. Bottom line inside: weight moisture content w of sand in %. Bottom line below the figure; relative moisture of air, in %.



Title of figure 5. Average cyclic curves of sand temperature and moisture content of sand and of intraporous air, which were obtained as a result of the experiment.

Experiments of this series were characterized by different duration (6 to 38 days), various number and length of seances, or cycles into which each experiment was subdivided, as well as by different ranges of temperature Δt(14-26.8°) and of vapor pressure ΔP(25-43 mm Hg) between ends of the sand column that is between the recipients.

Results of experiments, after necessary processing, were presented in

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the form of curves (figures 5 and 6), which reflect the re-distribution of temperature, of moisture content and of maximum hygroscopicity of sand along the height of the sand column during the course of each experiment, as well as the temperature and the relative moisture of the intraporous air; whereupon for the plotting of curves of the maximum hygroscopic moisture data of experiments on studies of the adsorptive capacity of the examined sand were utilized.

Appearance, during the course of each experiment, of two maxima of moisture content attracted our attention first of all: of the upper one - near the "dnevnoi" [daylight] surface (below the surface zone of evaporation) and the lower - at the base of the sand column. Between the upper and lower horizons of maximum moistening is found [Begin p.31] an area of a more or less constant humidity, which we called - "zone of transfusion of moist air" (2).

On the basis of analysis of the experimental data the origin of the upper, most important agriculturally, maximum of moisture content is explained in the following manner.

When the ground was heated from outside, a relative thermal diffusion of the moist air arose in its pores, which were partially filled with water, and, accordingly, the heavy ingredients of the air (nitrogen, oxygen, carbon dioxide) diffused from the warm layers into the cold ones, and the lighter water vapor in a counter direction. Occupying the central position in the pores of the soil, air forced the vapor back to the periphery of the pores. The specified separation of water vapor becomes considerably stronger when, as a result of a more or less prolonged heating of the ground, its parts not only on the irradiated surface, but also to a certain depth, become warmer than the air surrounding them. Under the in-

(2) In natural soils it corresponds to the "dead horizon" of G. N. Vysotskii.

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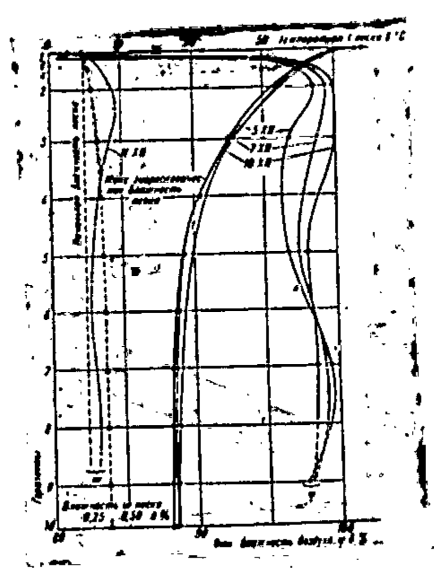
fluence of the thus forming transverse gradient of temperature in the pores of the soil arises a radial relative thermal diffusion, which increases the concentration of "heavy" gases (dry air) in the center of the pores, and of the water vapor at their sides. Vapor thus drawn back to the sides of the pores, having taken up their temperature, becomes lighter which then leads to an origination of convection currents in the pores.

Words in figure 6. Upper right corner: temperature t of sand in °C. Inside the figure: left vertical line - initial moisture of sand; horizontal upper line - maximum hygroscopic moisture of sand. Bottom left outside the figure: horizons; inside the figure: moisture w of sand in %. Right corner, line below the figure: relative moisture of air φ in %.



Title of figure 6. Progress of temperature of sand and of moisture of air in its pores during the second cycle of experiment II and changes in moisture content of sand as a result of the whole experiment II.

[Begin p.32]

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Simultaneously, meeting the vapor ascending along the sides of the pores, vapor is descending, moving from more heated layers into less heated towards the decline of its average partial pressure. Thus results a two-way flow of vapor into the layer of ground which is situated directly under the surface zone of evaporation which causes super-saturation of the intra-porous air, and, as a result of this, a condensation of vapor in this layer.

In conformity with natural conditions, the described process of migration of soil moisture (in its gaseous form), which is accompanied during favorable hydrothermic conditions by a condensation of vapor in the layer of soil where roots are found, undoubtedly, plays a substantial role in the general moisture exchange of the soil.

Importance of this [illegible] the re[illegible]tion of moisture supplies, which are expended by the soil for evaporation and transpiration becomes more obvious, if one considers the very substantial effect, which was detected during the course of [illegible] experiments and [illegible]nsists of the fact that during approximation, in these or other horizons, of moisture of sand to its maximum hygroscopicity readings of the "wet" thermocouples, which were installed in these horizons became steadily higher than the readings of "dry" or "soil" thermocouples which were introd[illegible] into these same horizons. This phenomenon, having appeared once, was after that observed continuously up to the time when the moisture of sand in specific horizons did not attain approximately its time and a half or double maximum hygroscopicity after which the difference of readings of "dry" and "wet" thermocouples, having passed over zero, changed its sign.

A detailed analysis of all circumstances, accompanying such inversion in the readings of "dry" and "wet" thermocouples, led to conclusion, that in the presence in the moist soil, the pores of which form a system of

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"continuous" capillaries that are in communication with each other, of the temperature gradient, which causes an uninterrupted circulation in them of the moist air, and in the presence in micro and macrocapillaries of the surface of liquid (menisci) of various curvatures under conditions of high relative moisture content of the intraporous air, in the pores of certain horizons of the ground there are possible and usually take place two opposite phenomena, that is: on liquid surfaces on menisci of smaller curvatures, occurs a plentiful condensation of vapor while from the neighboring menisci of greater curvature simultaneously moisture can evaporate more or less intensively. One should point out that this conclusion completely conforms with principles which were brought forward of late in the works of O. V. Shapovalova, V. K. Lebedeva, A. V. Lykov and certain other researchers.

Basing oneself on results of experiments, one can assume, that the described process of concentration of vaporous moisture in the layer of soil, which is under the surface zone of evaporation, with a fallowing condensation of vapor in this layer arises in the presence in the soil of a temperature gradient, which is set from below up (and, in general, is characteristic for the period of vegetation of plants). Being adopted to the layer of soil where roots are situated, this process gives the greatest effect when soil consists of aggregates (crumbs) which are saturated with moisture, the spaces among which form an extensive network of macropores, which provide for maximum intensity of circulation in them of moist air, or, in other words, when the soil has a fine crumble structure and in the active layer of soil (down to two or more meters deep) is contained a certain optimum reserve of water.

If one considers the fine capillary porosity of most natureal soil -

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grounds, which conditions in them a slow mobility of water in drop-liquid form, then it will be quite logical to assume that the deciding role in the renewal of moisture reserves in the root layer of soil, which are expended for evaporation and transpiration, under the specified conditions precisely belongs to the process of condensation of vapour from the moist [Begin p.33] air, which is circulating in the macrocapillaries of the soil according to a scheme, which was cited here.

Apparently the shallow horizons ("linzy" [levels?]) of fresh ground waters in the Ural Kara Kuma are indebted to a considerable degree for their origin to the cited phenomena of transmission of moisture in its gaseous form; for a skillful utilization of these waters for "bogarnyi" [dry farming] agriculture in the until then barren deserts of Kazakhstan a group of co-workers of Priaral'skaia Experimental Station, in 1952, were honored with a Stalin prize.

Experiments with sand, which was moistened hygroscopically, were supplemented by two experiments with sand of stepped up moisture content, which were conducted in order to find out the influence of the temperature gradient on re-distribution of moisture in all its forms in the sand, including the vaporous, film and capillary water.

The experiments were conducted with the same laboratory set-up without any re-equipment.

Before the experiments were started the sand that filled the earthenware pipe was moistened by means of watering it from above; before the first experiment it was moistened to about its "field" moisture capacity only in the upper, 80 centimeter layer of sand, while before the second experiment the entire sand was saturated with water up to its maximum moisture capacity.

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During the course of experiments, with the aid of heating and thermo-regulating apparatus of the upper recipient, a constant temperature drop was ket up in the sand column, which comprised in both experiments 27.6°. Same appliances and equipment, as in previous experiments, were used for observations of changes, under the influence of this drop, of the temperature and moisture of sand and of the intraporous air.

The main result, obtained from the first experiment is based on the comparison of simultaneous readings of "dry", "moist" and "soil" thermocouples in each of the six horizons of sand that were probed (table 1).

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Table 1.

No. of the horizon	Depth in cm	No. of thermometers and of thermocouples	Readings of thermometers and of thermocouples in °C		Weight moisture of sand in %		Maximum hygroscopic moisture content in %
			April 11	April 13	Initial April 9	After the end of the experiment April 14	
Upper recipient		s	44.40	44.60			
		m	41.40	41.40			
1(v)	1.5	1(v)p	37.40	37.65	1.05	-	0.25
		as	37.35	37.50			
		bm	37.20	27.85			
2	6.5	2p	32.50	32.70	1.20	0.97	0.27
		11s	33.40	33.75			
		12m	33.15	33.50			
3	15.5	3m	26.80	28.00	1.19	0.90	0.31
		13s	26.80	28.05			
		14m	27.00	28.25			
5	35.5	5p	19.10	20.50	0.82	0.57	0.35
		15s	19.30	20.75			
		16m	19.05	20.45			
7	55.5	9p	16.55	18.00	0.35	0.50	0.37
		17s	16.70	18.10			
		18m	16.50	17.95			
9	75.5	9p	15.50	17.10	0.57	0.59	0.37
		19s	15.75	17.25			
		20m	15.50	17.00			
Lower recipient		s	15.70	17.40			
		m	15.10	16.90			

[Begin p.34]

<u>Note:</u> Indicator "p" denotes thermocouples which show the temperature of sand; indicator "s" - thermometers and thermocouples which show temperature of "dry thermometer" (temperature of the air); indicator "m" - thermometers and thermocouples, which show temperature of the "wet thermometer". Thermocouple 2p, as it was later ascertained, because of inaccuracy, during the given experiment gave a lower reading (~by 1°). Inversion in readings of "dry" and "moist" thermocouples in horizon 3 ($t_m > t_s$) was, apparently, a result of condensation of water vapors in this horizon. Nevertheless, the lowering, towards the end of the experiment, of the moisture of sand in this horizon, as well as in the whole upper part of the column, testified to the fact that under conditions of sharp non-uniformity in the distribu-

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tion of moisture along the height of the sand column the movement of moisture was predominantly from top to bottom in drop-liquid form, from warmer, more moist horizons to colder, drier horizons.

A characteristic difference in these readings ($t_n < t_p < t_s$) indicated a non-saturation by moisture of the intraporous air almost along the whole thickness of the sand, including the horizons the moisture of which was several times higher than the maximum hygroscopicity of sand. And the non-saturation by moisture of the intraporous air serves as a direct evidence of the presence of inside the soil evaporation in specific horizons of sand, which, in its turn, indicates a possibility of intensive migration of soil moisture in vaporous form in the deep thickness of soil-grounds.

Before the beginning of the second experiment specimens for moisture content were taken through extraction branch pipes when the flow of gravitational water, which as it was previously mentioned , was used to saturated the sand preliminarily, stopped its flow from the container. Distribution of moisture which was detected at that time is shown in table 2, column 7.

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Table 2.

No of the horizon	Depth in cm	No. of thermometers & thermocouples	Readings of thermometers and thermocouples in °C			Weight moisture of sand in %	
			April 19	April 21	April 29	Initial April 16	After the experiment April 29
1	2	3	4	5	6	7	8
Upper recipient		s	44.90	44.70	44.15		
		m	36.60	35.00	-		
1(v)	1.5	1(v)p	34.00	35.50	37.90	0.54	0.26
		as	35.95	35.40	37.77		
		bm	35.55	34.40	35.92		
2	6.5	2p	30.30	29.10	29.57	2.47	1.44
		11s	30.15	29.05	29.40		
		12m	30.10	29.15	29.00		
3	15.5	3p	26.50	25.75	24.60	2.68	2.89
		13s	26.40	25.60	24.60		
		14m	26.35	25.55	24.60		
5	35.5	5p	21.35	20.75	20.60	2.68	2.57
		15s	21.35	20.75	20.40		
		16m	21.25	20.65	20.36		
7	55.5	7p	19.15	18.60	18.60	2.51	2.54
		17s	19.20	18.65	18.45		
		18m	19.10	18.55	18.42		
9	75.5	9p	17.75	17.30	17.28	2.98	3.20
		19s	17.90	17.40	17.28		
		20m	17.80	17.30	17.28		
Lower recipient		s	17.20	16.60	16.70		
		m	16.10	15.30	16.60		

Footnote: The observed surpassing in readings of "dry" and "wet thermocouples, towards the end of the experiment in the "zone of "transfusion", at a sameness of the last two, is connected to an attainment of a certain quasi-stationary condition of the temperature field in the experimental sand, which is, generally speaking, not characteristic of the thermal conditions of natural soils-grounds.

Passages, which remained in the sand in front of the extraction [Begin p.35] branch pipes, were immediately filled with sand that had been saturated with water to a moisture content $W \approx 14\%$. After this in the sand was established the above cited temperature drop Δt.

Four days later, sand, which we used to fill in the cavities in front of extraction branch pipes, was extracted and its moisture content was

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determined by a gravimetric method. It proved to be that moisture of sand was reduced everywhere from 14 to 8(± 0.15)%.

Seven more days later we again examined the distribution of moisture in the sand, but now in the central part of the container and at this time we inscovered two horizons of increased moisture: one-at a depth of ~20cm and the other - at the base of the sand column (table 2). At the same time the average moisture content of the basic part of sand, at a depth of 10-70 cm remained constant.

During the course of the experiment periodically readings were also taken from all the thermocouples, that were introduced into the sand, as well as from psychrometers, installed in the recipients; some of them are cited in table 2.

Analysis of the cited experiment data permits to ascertain, that during moisture content of the soil, which exceeds its maximum water capacity, the soil moisture is fully in the power of gravitational and capillary forces, and the influence of the thermal factor is negligible during such an extent of soaking of soil. Nevertheless, the experiment also showed, that in the soil-ground, moisture content of which yet does not exceed the maximum water capacity, a circulation of moist air arises according to a scheme cited previously, under the influence of a descending heat flow. The circulation is accompanied by a condensation of vapor in the warmed layers of ground, which are situated below the surface zone of evaporation, and which acquire an increased moisture content because of the condensation.

In connection with the shifting (deepening) of the evaporation zone the horizon of condensation also is shifting gradually. Thus, if on April 21 this horizon was found in our sand column at the depth of 6-10 cm, that is

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there, where the readings of "wet" thermocouples were higher than readings of "soil", and especially of "dry" thermocouples, then at the end of the experiment it proved to be at a depth of 15-20 cm where, due to the excess of moisture, all thermocouples started to show one and the same temperature, that is - the temperature of the water.

Below the horizon of condensation we had all the time a clearly expressed "zone of transfusion" with correlations characteristic for it between readings of thermocouples: $t_m < t_p \gtrsim t_s$, where t_p was reading of the "soil" thermocouple, t_m - of the "wet" and t_s "of the "dry" thermocouples, whereupon above the zone $t_p > t_s$ and below the zone $t_p < t_s$.

These experiments, thus, once again proved the accuracy of the original principle that moisture, sorbed by the soil from the moist air circulating in its pores, is a substantial credit element of its water balance under certain conditions.

Finally, it is necessary to point out, that our conclusions about the positive influence of a thermal factor on re-distribution of moisture in the soil, which resulted from experiments with a stationary method of heating a model soil-ground, can be applied in one or another degree also to natural soil-grounds during periods of prevalence in them of temperature gradients of the same sign, that is, mainly during the warm time of the year or during the day. During a summer night, in the presence of a temperature gradient, which is directed downward, in the upper part of the active layer of soil predominate phenomena of diffusion, thermodiffusion and convection, by virture of which the soil moisture rushes to the surface of the soil.

The largest part of moisture, which entered the uppermost layer of soil and evaporated during the day, quits the soil's moisture turnover. As

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one of the most radical measures for not only curtailing useless expenditure of soil moisture in evaporation [Begin p.38] but also accumulation of the soil and of extra soilmoisture, that is entering into the soil from the native rock and the atmosphere in the root - inhabited layer of soil, it is apparently necessary to acknowledge the formation of the air-tight interlaminations of V. G. Kornev.in the soil.

Conclusions

1. Between the water and the thermal processes of the soil there is a regular link, which is brought about by means of evaporation from the surface of the soil, as well as through the processes of intrasoil evaporation and condensation.

2. Processes of intrasoil evaporation and condensation are accompanied and, to a great degree, conditioned by the circulation of moist air in the soil pores, which are not filled with soil solution.

3. Vertical gradients of temperature of the soil prove to be the incentive to circulation. Under the action of temperature gradient the heavy components of the soil air (nitrogen, oxygen and carbon dioxide) move chiefly in the direction of the heat flow, and the lighter water vapor moves in the opposite direction. tThe full stratum of the so-called active layer of earth can be encompassed by such a circulation.

4. As a result of circulation of moist air in the soil-ground during the warm time of the year two horizons of condensation are usually delimited: the upper one, situated in the layer of ground in which the downward current of moist air that is being sucked into the soil meets the convectional currents of moist air bathing the walls of the pores; and the lower is adapted to

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to the layer of constant temperature where, because of the reduction of the temperature gradient to zero, the molar movement of soil gases and of water vapors, mixed with them, ceases. Accumulation here of water vapors leads to its condensation in the pores of this layer.

Between the upper and the lower horizons of condensation there is a region of a more or less constant moisture (the so-called zone of trans-diffusion). In most cases the upper horizon of condensation is isolated from the external surroundings (atmosphere) by the surface zone of evaporation.

5. The process of concentration of vaporous moisture in the layer of soil-ground, underlying the external evaporation zone, with a subsequent condensation of vapor in this layer, which develops in the presence of a downward, temperature gradient in the soil, produces the greatest positive effect, when the soil consists of aggregates (crumbs) that are saturated with moisture and the space among which forms a developed network of macropores, or, expressing it otherwise, when the soil has a fine crumble structure and in the active layer of the soil-ground there is contained a certain optimum reserve of water.

6. Considering all this, as well as a weak mobility of drop-liquid water in most natural especially in structural, soil-grounds one can assert that the above cited process of condensation of vapor from the moist air, which is circulating in the macropores of the soil, is playing a deciding role, under certain circumstances, in the restoration of moisture reserves in the root inhabited layer of soil which are expended by the plants for transpiration.

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